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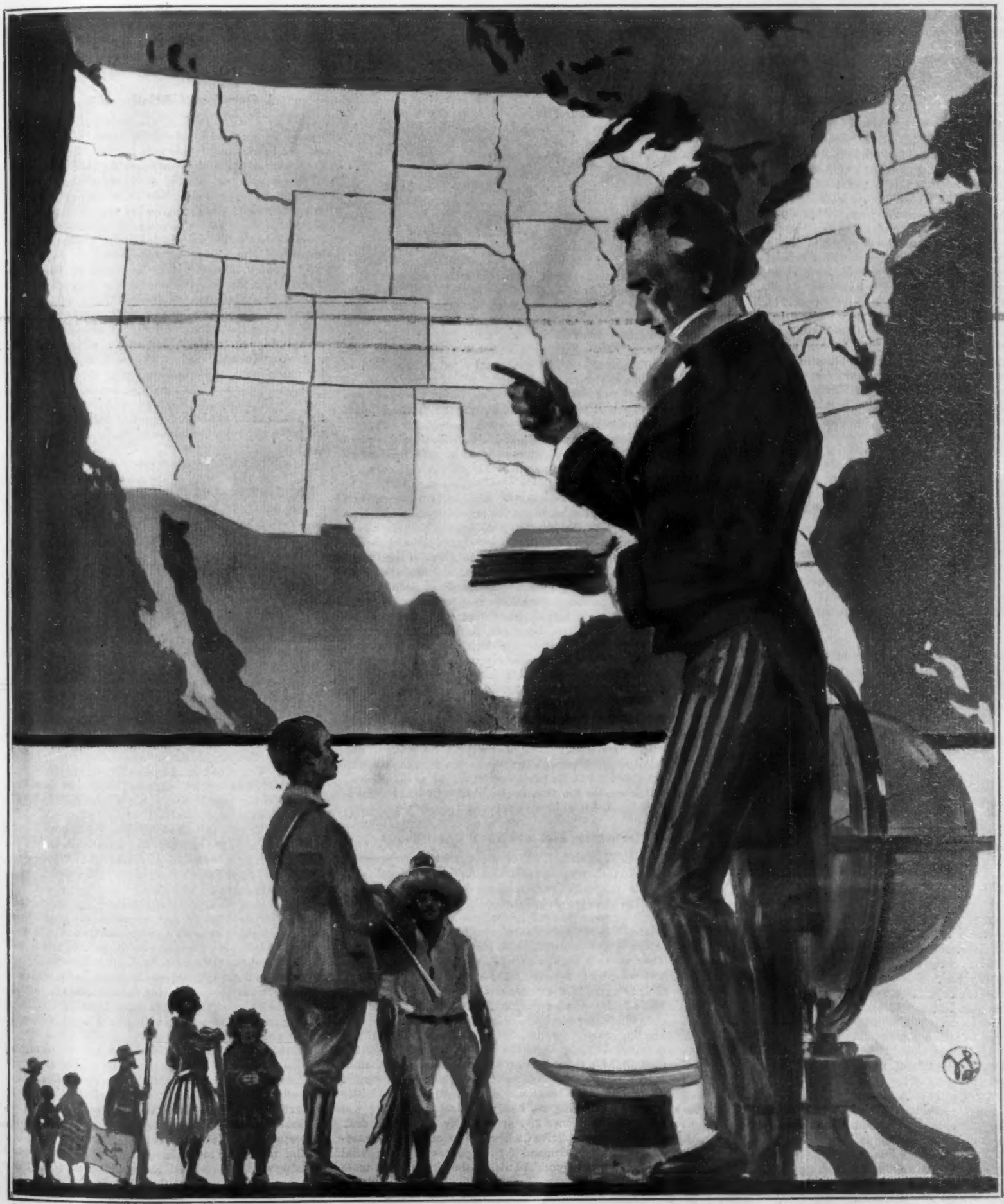

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*Reading from left to right:* Danish Islands Samoa Guam Panama Canal Zone Hawaii Alaska Philippine Islands Porto Rico

**UNCLE SAM'S CLASS OF 10,454,494, FROM OUR OUTLYING POSSESSIONS** (See page 328)

# SCIENTIFIC AMERICAN

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*The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.*

*The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.*

## A State of War

WE are embarked in the great European War. Of that there can be no doubt whatsoever. Our entrance into the conflict took place on that fateful day, the 17th of March, when three of our peaceful and unarmed merchantmen were sent to the bottom and fifteen unfortunates were added to the two hundred or more American citizens, whose lives have been snuffed out by German lawlessness and brutality.

Not only are we at war, which in itself is a very serious matter, but we are at war with the most powerful, unprincipled and ferocious military system in all the history of mankind. We have not sought this conflict, God knows. Rather, we have extended charity, patience and forbearance to their very limits. In this respect we have been true to our national traditions. The history of the United States, from the war which gave birth to this nation down to the conflict in which we are now engaged, bears witness to the fact that we are a peace-loving people, desirous of living on terms of amity with all the world, who have never taken up the sword except with great reluctance and after every other expedient has failed.

Since the war is now actually upon us, the immediate and insistent question which we have to answer is, what kind of a war are we going to wage? Is it to be a war of offense or of defense? Do we intend to carry the war to the enemy, or is it our purpose merely to set a guard at the gates and await his coming?

Manifestly, if we are a peaceable people, possessed of an inborn hatred of war, it will be our desire, now that we are actually at war, to do all we can to hasten its conclusion; and it must be evident to the simplest intelligence that, if we confine ourselves to a mere defense of our borders, and wait for an enemy who may never come, we shall contribute very little toward hastening the end of this great world tragedy.

On the other hand, in spite of our acknowledged military unpreparedness, we are in certain respects most favorably placed for waging an offensive war of such overwhelming effect that we can render the ultimate defeat of the Central Powers an absolute certainty.

In the first place, we can put the financial standing of our allies upon such a sure basis that they will be relieved of all anxiety as to the financing of the war, no matter how long it may last. Although the financial resources of the Allies are much greater than those of the Central Powers, there can be no doubt that the burden bears down upon them with crushing weight and is beginning to be the subject of grave misgivings. At the outset of the war we were potentially the richest of the nations, and in the intervening years our wealth has increased enormously. The realization by Germany of the fact that back of the resources of Great Britain and France there lies the vast treasure house of the United States, may well seem to them to be the handwriting on the wall, spelling out in unmistakable characters the inevitable collapse of the Teutonic cause.

Of scarcely less potency for bringing the war to a speedy conclusion are the vast industrial resources of this country. If we immediately mobilize them for the manufacture of munitions and military supplies, we shall make it possible for our allies to exert their great preponderance of man-power in the field and at the front. A few weeks ago, before even the rumors of the great Russian revolution had reached us, we suggested that if we wished to strike a decisive blow on the battlefields of Europe, we could do so most effectively by arming and supplying the many millions of reserve troops in the Russian Army, which cannot now be used at the front because they are lacking in munitions and equipment.

Russia has become, like us, a great democracy. Hence there are compelling reasons of sentiment and mutual aspirations which would render our munitionment of Russia particularly appropriate. There is no finer fighting material in Europe today than the stalwart Russian peasant. Now that the army has been purged of the poison of Prussian intrigue and relieved of the burden of bureaucratic incompetency, we believe that, if its millions were amply equipped, it would move forward under the brilliant leadership of Nicholas and Brusiloff to an overwhelming victory. The Pacific Ocean is not infested by submarines and shipment of munitions by way of Vladivostock and the Trans-Siberian Railway would be unimpeded. Moreover, our munition ships, under convoy of our own and the Allied fleets, would be able to make deliveries through the ports of Northern Russia.

If it is our intention to throw our whole power into a strong offensive, it will be through the Navy, of course, that our principal military effort will be made. Acting upon the long-established principle of all military warfare, we should seize the initiative and carry the fight into the enemy's territory. Germany has announced that her hopes of victory are centered in the submarine war, and it is our firm belief that she has suspended all work on capital ships and is devoting the full capacity of her shipbuilding yards and workshops to the turning out of submarines of large size. Here then, in those waters in which submarines are most active, we should strike at once and strike hard, reserving a sufficient motor-boat control to take care of any occasional U-boats which may be sent across the Atlantic. We should immediately coöperate with the Allied navies in smothering the submarine attack in its own chosen waters, namely the approaches to the British Isles, to the French ports and to the Mediterranean. We have, in commission and reserve, a fleet of about fifty destroyers with another twenty-five under construction, which could be speeded up so as to be available within the year. We should start construction on not less than a thousand of the proposed 110-foot submarine chasers; and if these and our destroyer fleet were dispatched to the submarine-infested waters, the sinking of Allied ships would be so greatly reduced as to make it quickly evident to the Germans that their last hope of striking a decisive blow at sea was gone. These methods of offense, coupled with the thorough arming of our merchant ships, and the construction of a large fleet of wooden motor-propelled freight ships, would enable us to exert an enormous influence in keeping open the lanes of sea travel for the flow of our munitions and supplies to Allied ports.

Although our quickest and most effective blows can be struck upon the sea, we should at once bend every effort to the development of adequate land forces. It should be one of the first duties of Congress to pass the Chamberlain universal service bill; and for the credit and honor of the United States we should send at least two army corps to the western front, just as soon as we can provide their complete equipment and munitionment.

In conclusion, we believe that the people of the United States should make it clear to the Administration that they feel that the hour has struck when words should give place to deeds, and those great principles, of which we have heard so much of late from the lips of the Administration, be given instant and practical application. In the two months which have intervened since the German Ambassador was dismissed, there have been too many words and too few deeds. We have heard so much about what we were going to do and we have seen so lamentably little done. What has been accomplished has been brought about by private effort and the expenditure of private monies. In all the confusion, anxiety and uncertainty of the past two months the initiative has been with the people, not with the Government. It is now for the Administration to take the lead and prosecute the war, confident that it has behind it the loyal and unanimous approval of the whole country.

## Plunging Fire and Naval Construction

A DEVELOPMENT of the war which is pregnant with great possibilities for future naval construction is the increase in the caliber of guns and the corresponding increase in the ranges at which future engagements will be fought.

The British are credited with having built some extremely fast cruisers, which mount a new 18-inch gun. They are very slightly armored and hence their obvious tactics will be to fight at the longest ranges at which their fire would be accurate and effective.

We believe that, given good vision, 20,000 yards and over will be the selected fighting range of the ship mounting the heavier gun and having the speed-gage of the enemy. At such ranges the average angle of fall of the shell will be over twenty degrees, and the horizontal target will be more than twice that which was presented by the vertical target under the old 10,000-yard battle range. This being so, heavy vertical side armor will give way to thinner and more widely distributed deck armor. The protective deck will take on added importance, and the demand for keeping everything vital as low down as possible within the ship will be more imperative than ever.

A solid shot of 14- to 18-inch caliber, coming down at that angle, would of course go clean through the ship, protective deck or no protective deck. But the day of solid shot has passed, and hence the effort of the naval constructor will be to insure the bursting of these big shells well up in the upper structure of the ship, so that only the fragments will reach the protective deck below.

It is conceivable that in future ships thin side-armor, covering the whole top sides, associated with a lightly armored top deck, both of these to act merely as shell-bursters, may be associated with a heavy protective deck below.

In view of these considerations, the utter futility of hoping to protect the boilers of our new battle-cruisers, which have been placed above the water-line, is evident. The sponsors for these ships have spoken of certain "special" protection, which has been given to these above-water boilers. Whatever this is—light armor, bulkheads, or what not—when struck by a 16- to 18-inch shell, it will serve only as a shell-burster, and will merely insure that these fragments will make certain wreckage of the nests of boilers, placed just below the upper deck. Put them below the protective deck, and they would have at least a fighting chance. Placed where they are, they would have none whatever.

## A Question of Relative Efficiency

A FURTHER study of the comparative efficiencies of the geared and electric drives, made since the battle-cruiser bids were opened, brings out the fact that the geared drive will surely give a much higher efficiency than the electric drive under the conditions existing in these vessels. The superiority of a properly designed geared drive will be not less than twelve per cent; that is to say, the required horse-power on the propeller shafts can be obtained with twelve per cent less steam than with the electric drive.

This gain in efficiency is due to several considerations. The turbines used in the case of the electric drive are subject to an inherent drawback. Even with the enlarged accommodation due to half the boilers being placed above the protective deck it is necessary to make each turbine in a single section or casing with two bearings. To make each in two sections would require too much room. The turbines being thus restricted in length, the number of stages that can be used is quite limited. Moreover, as there are only four turbine units the steam areas at the low pressure end cannot be made adequate without using buckets of prohibitive length and therefore the vacuum cannot properly be taken advantage of. As it is, the buckets are excessively long.

In the geared drive, on the other hand, the turbines are built in several sections, two of these being in series at full power, so that more stages can be used and a higher efficiency obtained. Moreover, because of the fact that there are twice as many low pressure turbines and each one is of the double-flow type, the steam areas provided at the exhaust end are very much greater—over fifty per cent. The result is that even with moderate bucket lengths it becomes practical to provide much larger steam areas and thus take full advantage of the vacuum.

The increased number of stages combined with the increased areas of the low pressure elements will, it is estimated, give a total improvement in turbine efficiency of not less than eight per cent.

This improvement will be partly offset by a slight increase in bearing losses, losses in piping connections, and those due to the reversing wheels, which combined will not amount to over three per cent, giving a net gain in turbine efficiency on the turbine shafts of at least five per cent. Since the transmission efficiency of the electric drive, including cables, will be about 92 per cent and that of the geared drive 98½ per cent, there will be a gain in transmission efficiency of 6½ per cent. This added to the gain in turbine efficiency will give a total gain in power on the propeller shafts of about twelve per cent. With a vacuum of anything like 28½ inches, which these large ships should carry, the gain might be considerably more.

If no change in the boiler plant were made, this increase in power would give an increased speed of just one knot, making the ship a 36-knot instead of a 35-knot cruiser. If, however, no increase of speed is attempted, one-eighth of the boilers can be eliminated, which would result in a substantial increase in space and a saving in weight of about 200 tons. This, in addition to the weight saving which the shipbuilders have heretofore counted upon, namely, 1,000 tons, will give a total saving in weight of ship of over 1,200 tons.

As there is no difficulty with the present forms of turbine in securing as good economies at low power as can be secured with the electric drive, and as the boilers and all auxiliary machinery can be placed below the protective deck if the geared drive is used, it is evident, if the above estimates of economy are true, that the Department's decision to use the electric drive will, if carried out, be a greater blunder than was thought when the shipbuilders presented their bids more than three months ago. It is evident that if the Navy Department had referred the question to a board of disinterested experts, the investigation could have been completed and the advice of such a board had by this time.

## Electricity

**Luminous Efficiency of the Electric Arc.**—A recent contribution by E. Karrer in the *Journal* of the Franklin Institute describes some tests on the luminous efficiency of the radiation from various types of electric arcs. The measurement was carried out by means of thermopiles which could be shielded by cells containing special solutions transmitting only the luminous rays The highest efficiency, about 19 per cent, was recorded with yellow flame carbons. This figure refers only to the nature of the radiation and losses in the lamp itself.

**An Electric Water Heater** that can be readily attached to any plumbing and that takes its energy from the nearest lamp socket has recently been placed on the market. The heating element is always submerged so that it cannot be exposed to a higher temperature than that of boiling water. The same motion that turns on the water also turns on the current; the device is in reality a faucet. The water is heated in three seconds, and any quantity from one pint to one quart per minute can be drawn from the faucet, depending upon the temperature required. If the current is disconnected the faucet can be made to pass cold water. The device weighs one pound, and can therefore be carried by travelers and tourists.

**Electric Elevators Aboard Steamers.**—At a meeting of the Belfast Association of Engineers held recently, a paper on "Electric Lifts on Land and Shipboard," by Mr. C. G. Major, was read. The installation of electric elevators on ships presents special difficulties, owing to the pitching and rolling of the vessels, states *The Electrician* in its report on the paper. The guides, for example, must be specially stiffened and yet, since no part of a vessel in motion is absolutely rigid, there must be flexibility and "give." The swinging control cables below the cage are considered to be a nuisance, but the alternatives are even more inconvenient. The fittings inside the well must accordingly be so fixed that the free swinging cable cannot possibly hitch on them, whatever the motion of the ship.

**An Electric Floor-Polisher.**—A device of great importance has just been invented for practical use in the home. The task of keeping a floor polished to the required brightness was perhaps the most difficult task of the home and the little machine which does the work without any effort on the part of the operator is a welcome addition to the household appliances. Hours were once spent to spread the wax on evenly and give the floor-surface the required brilliancy. Now with this little machine, fastened to the nearest electric light socket, the work loses its drudgery and the floor is finished in much better condition than was possible by hand. An applicator, which goes with the outfit, spreads the wax on the floor and the polisher, which consists of a massive bristle brush revolving at 3,000 revolutions per minute, does the work, All the operator does is to guide the polisher across the floor. No pressure is required.

**Radio Telegraphy in 1916.**—In a review of the progress of telegraphy in 1916, the *Journal Telegraphique* gives a list of the more important radio telegraph stations opened during the year. It is stated that communication has been opened between the following points: Isle of Tahiti to Samoan Islands and from there to New Zealand; Atar and Chinquetti (Mauretania) to Port Etienne; Cape Juby to Isle of Teneriffe; the Continent of Australia and Tulagi and the Solomon Islands in the Gilbert Archipelago; Seattle and Yokohoma; Barcelona and Budapest. The following transatlantic stations are in operation: Sayville, N.Y., and Nauen, Prussia; Tuckerton, N. J., and Eilvese, Prussia; Chatham, Mass., and Stavanger, Norway; Marion, Mass., and Nairbo, Norway; Belmar, N. J., and Carnarvon, Wales; New Brunswick, N. J., and Towyn, Wales; Glace Bay, N. S., and Letterfrack, Ireland; Louisburg, N. S., and Clifden, Ireland.

**Is Trench Foot an Electrical Phenomenon?**—In a recent article by Dr. C. N. Longridge in the *Lancet* it is stated that the sores accompanying "trench foot" have a close resemblance to the tropic sores which accompany certain diseases of the central nervous system. Dr. Longridge applies a theory of Mr. A. E. Baines to explain these effects on an electrical basis. It is suggested that the normal condition of the body involves the constant circulation of currents through the nerves, which operate as insulated cables. When, however, a man is standing continually in water, so that his extremities and a considerable surface of the skin have their electrical resistance enormously diminished, a constant leakage of current takes place. This apparently interferes with the continued action of the "electrical generator" believed to be located either in the brain or the spinal column. Experience has shown that the best safeguard against trench foot is to cover the feet with grease; similarly swimmers on long distances anoint themselves with oil. It has usually been assumed that the beneficial action of this treatment is due to the grease or oil acting as a heat insulator, but according to the theory of Dr. Longridge it is rather its qualities as an electrical insulator that renders such a covering valuable.

## Science

**The Pacific Division.**—The second annual meeting of this recently organized section of the American Association for the Advancement of Science is announced for Stanford University, April 4th to 7th. All the affiliated organizations are to be represented, and the occasion promises to be a very successful duplication on a smaller scale of the familiar national gatherings.

**The Weston Normal Cell,** which is the primary standard of electromotive force, has been the subject of elaborate investigations by the Bureau of Standards, the purpose of which is to increase both the accuracy with which this cell may be reproduced and its constancy with time. It is expected that in the near future the Bureau will be able to lay down specifications for the preparation and purification of all the standard cell materials, so that anyone, taking proper precautions, may reproduce the Weston normal cell to an accuracy of at least a few parts in 100,000.

**New United States Life Tables.**—The first publication of the United States Census Bureau devoted exclusively to life tables was recently published. It is entitled "United States Life Tables, 1910," and contains twenty-five tables prepared under the supervision of Prof. James W. Glover, of the University of Michigan. These tables are based on the census enumeration of 1910 and the mortality statistics of 1909, 1910 and 1911 in the original "registration" states, which includes besides New England, New York, New Jersey, Indiana, Michigan and the District of Columbia. They give the mortality rate and expectation of life at each age, not only for the aggregate population, but separately for sexes and races, foreign and native population, and rural and urban population. Tables of this character heretofore employed have commonly been based upon foreign statistics not applicable to this country. Among the facts brought out by the new tables are a great excess of city over rural mortality, and a much greater average expectation of life at all ages among women than among men. Rural women of certain ages, however, present an exception; from ages twenty-five to thirty-one their mortality rate is greater than that of men.

**The Neglect of Maps.**—Commercial Attaché Julean Arnold states that in touring the United States to aid American manufacturers and merchants to a better understanding of their trade opportunities in the Orient he found a deplorable scarcity of maps in chambers of commerce, manufacturing plants and business offices. Even the foreign trade departments of such establishments seemed to be rarely equipped with foreign maps. He adds: "I found everywhere throughout the United States a deplorable ignorance of the geography of the Orient. For some unaccountable reason people seem to look upon China as a country entirely within the tropics. When I mentioned Peking as being in the same latitude as Philadelphia, there was much genuine astonishment displayed. We must know more about, or, I might better say, *something* about the geography of foreign countries if we would extend our trade abroad." Mr. Arnold urges a much wider use of maps of foreign countries, but he fails to urge what is equally important; viz., the use of accurate and up-to-date maps. This would be almost equivalent to saying, maps made abroad; because maps of foreign countries made in the United States are, for the most part, positively ludicrous in their crudity and out-of-dateness. Mr. Arnold is American commercial attaché in China. It would be interesting to hear his opinion of the maps of that country found in the typical American atlas.

**Isostasy** is the hypothesis (now sufficiently well established to be called a theory) according to which, at a certain depth beneath the earth's surface, all equal areas sustain the same loads; in other words, equal masses of terrestrial matter lie above them. Temporary disturbances in isostasy, due to shifts of material at the surface, are compensated by movements in the substratum. The investigation of this subject has of late been prosecuted, especially in the United States Coast and Geodetic Survey, by means of gravity observations, at first under the direction of J. F. Hayford, and more recently by William Bowie, and the Survey has just published the fifth of a series of elaborate memoirs setting forth the results obtained. It is found that isostasy exists in a nearly perfect form in the United States as a whole; also that there is nearly perfect isostasy in areas which form comparatively small percentages of the entire country. The depth of compensation—*i. e.*, the depth below sea-level at which, isostatic compensation is complete—as derived from 216 stations in the United States is 60 kilometers, but a much greater depth is found from mountain stations, and in the last memoir above mentioned, Mr. Bowie concludes that 96 kilometers is the best value now available. The memoir contains a bibliography, from which it appears that the first work containing extensive calculations bearing on isostasy was a paper published by Archdeacon J. H. Pratt in 1855, while the word "isostasy" was probably introduced by Major C. E. Dutton in 1889.

## Industrial Efficiency

**Old Footwear in the Foundry.**—Wearing of old shoes in the foundry is a bad idea. In case of a spill, a shoe which is in bad condition will allow the molten metal to reach the skin and burn it It is cheaper, in the long run, to spend money for a new pair of molder's Congress shoes. The use of Congress shoes as well as the leggings is advised. A very good type of legging, worn in some foundries, is made of asbestos in the shape of a boot and covering the entire top of the foot. It is held in place by steel bands which are sprung over the leg.

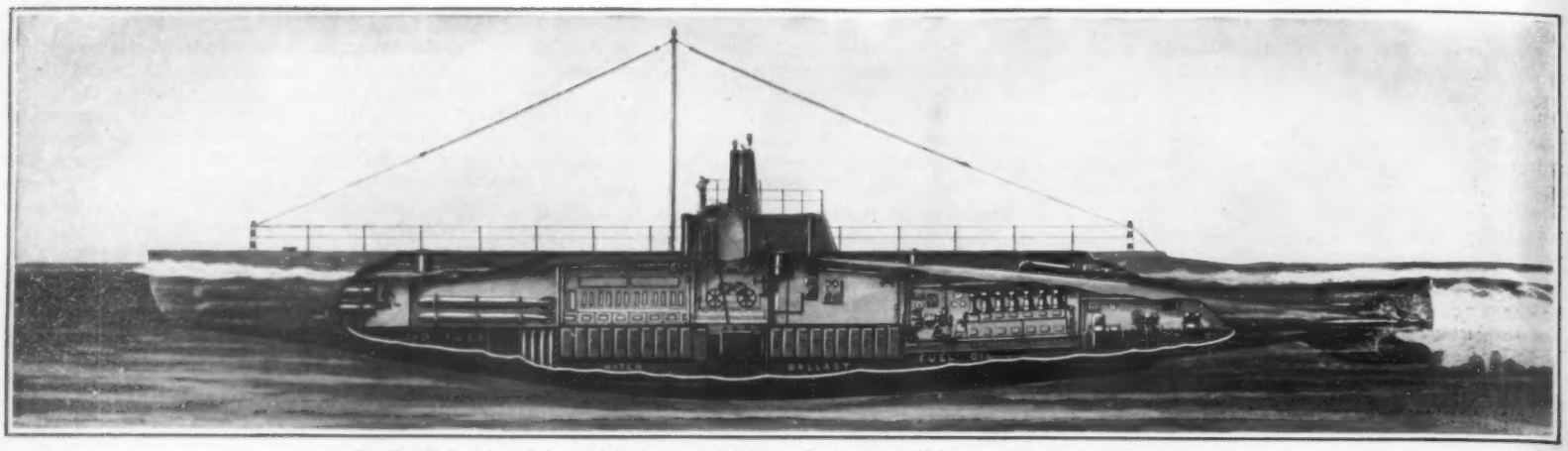
**Honduras Railroad Using Wood as Fuel.**—Owing to the continued high price of coal the Honduras National Railroad has abandoned this article as a fuel and is using wood cut along the line of the railroad The merits of coal and wood as fuels have been worked out carefully by this railroad, and when coal again becomes stabilized at a price sufficiently low, the use of this fuel will be resumed. During former periods of high-coal prices this railroad has resorted to the use of "coroza" or "cahoon" nuts as fuel, and while from a standpoint of economy and steam produced they have proved satisfactory, the intense heat generated was detrimental to the boilers.

**Efforts to Revive Chinese Porcelain Industry.**—Although porcelain is a characteristic product of China, the industry has been seriously falling behind in recent years. One important cause is the manner in which it is affected by the likin taxes. For centuries the home of the best Chinese porcelain has been the comparatively inaccessible town of Kingtehchen, in Kiangsi Province, and it is said that goods forwarded from there to Shanghai for export have to pay likin no less than 18 times besides other exactions. The abolition of these imposts presumably will constitute a part of the general problem of dealing with the likin, but the reform is especially advocated in the interests of this ancient Chinese art by the National Trade Protection Society, in coöperation with the Porcelain Trade Guild. Besides their efforts in this direction they are making plans for restoring the designs and quality of the product.

**Cost Finding in the Painting Business.**—"Cost finding with reasonable accuracy is not as difficult as is generally supposed, and it can be practiced without great expense," the International Association of Master Painters and Decorators of the United States and Canada was told at its annual convention at New Haven, Conn., recently, by Special Agent Walter B. Palmer of the Bureau of Foreign and Domestic Commerce. "If there is some additional expense for keeping cost-finding records, which is not probable in the case of the small contractor," he added, "it will be more than offset by the insurance against inaccurate computations in bidding." Mr. Palmer in his address, discussed in detail the requirements of the business represented by the members of the convention, and said that until the industry adopted a uniform cost-finding system, it would suffer the evil results of wild, reckless bidding. He urged the master painters and decorators of America to keep pace with the forward movement.

**Increasing Interest in Shark-Skin Leather.**—The interest that has been aroused by efforts to establish a wider utilization of the skins of sharks in the manufacture of leather has resulted in the receipt of a large number of letters by the United States Bureau of Fisheries from persons and firms connected with the leather trade or industry. Much work was done by the Bureau during the past two months. At present it has on hand about one hundred small shark skins and about fifty large ones. Many of these were shipped from Seattle. About twenty communications have been received expressing a desire to experiment with this product and the raw material will be supplied as far as possible. Manufacturers and brokers have been advised of possible sources of supply and an effort made to interest fishermen in this fishery. The possibility of using skins of other fishes has not been overlooked. Skins of several species have been ordered for experimentation and will be supplied to tanners when received.

**The Factors Largely Responsible for Poor Illumination** are small, narrow windows, low power artificial lights placed too far from the point of operation, and neglect of facilities at hand for obtaining light, according to the Pennsylvania Department of Labor and Industry. By this neglect is meant lack of cleanliness. This applies first of all to the windows. There is scarcely a single industrial locality which does not contain at least one building, and all too frequently several buildings, of the same type. They are built with a supply of window space sufficient to illuminate amply the interior. The dust and dirt accumulated upon them, however, destroy in large proportion their usefulness. The same condition is found in artificial lighting. The electric light bulb, dusty or streaked with dirt, the result of hurried and incomplete attempts at washing, often shaded with a fixture meant to be a reflector, but which in reality is anything but that, faintly illumines the work and impairs the health and the efficiency of the worker.



*Length*, 230 ft. 6 in. *Submerged displacement*, 913 tons. *Surface speed*, 17 knots. *Submerged speed*, 12 knots.

**The 800-ton (surface displacement) seagoing submarine, a size favored by our naval officers**

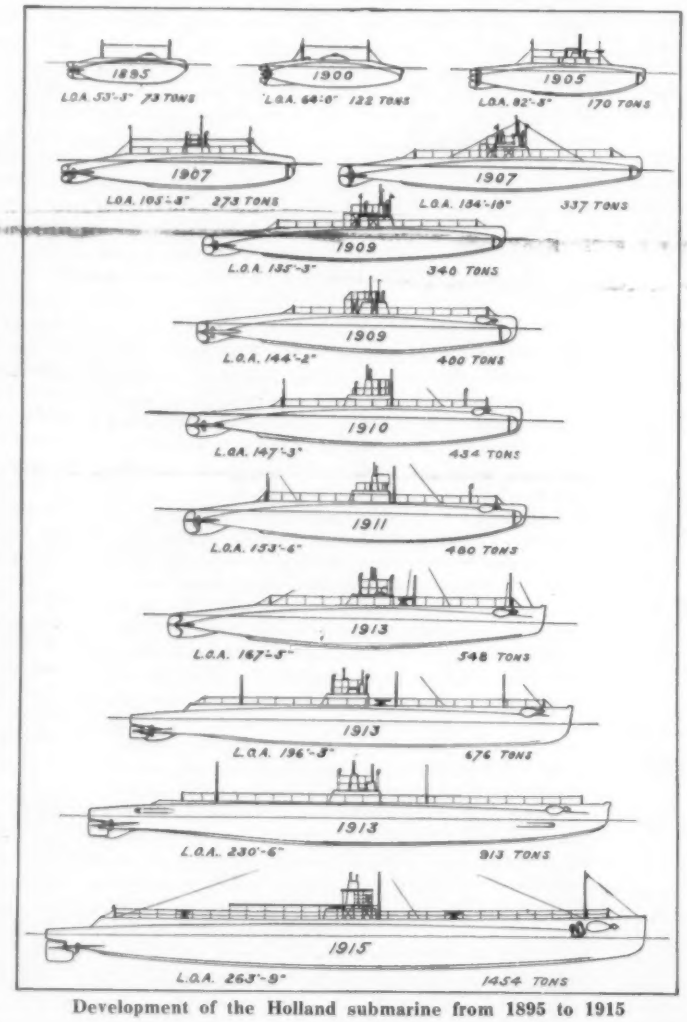
# Twenty Years' Development of the Holland Submarine

## Growth from the 73-Ton, 6-Knot Boat of 1895, to the 1454-Ton, 20-Knot Fleet Boat of 1915

THE accompanying diagrams and wash drawings tell the story of the past two decades of the development of the Holland type of submarine boat with such detail as to its essential features as to render any lengthy verbal description superfluous. It takes but a glance at these drawings to realize how unjust is the too frequently heard criticism that this country has not kept pace with the rest of the world, and notably with Germany, in the art of the submarine construction; for not only is it true that to the United States is largely due the credit for developing the first practical submarine, but it is equally certain that those private shipbuilders, who have devoted themselves to submarine work, have been steadily and consistently improving the type and keeping fully abreast of modern development.

Starting with the year 1895 we find that the Holland boat was a little craft 53 feet 3 inches in length, displacing in the submerged condition, 73 tons, capable of steaming five knots submerged and six knots on the surface, and that its radius at cruising speed was 200 miles. During the following decade the length had increased to 82 feet 5 inches, the speed had gone up to 8 knots submerged and 8¾ knots on the surface; the displacement had increased nearly two-and-a-half times, and the cruising radius had increased over four times, or 200 to 850 miles. During the next five years there was a remarkable all-round increase, the length going up to 147 feet 3 inches and the submerged displacement to 434 tons, the submerged speed rising to 10½ knots, and the speed on the surface to 14 knots, while the cruising radius showed an increase of nearly three times, reaching 2,300 miles.

In the next following five years, from 1910 to 1915, the development was even more rapid than in the five years preceding. The length was almost doubled, increasing from 147 feet 3 inches, to 263 feet 9 inches; the displacement was trebled, rising from 480 tons to 1,454 tons submerged; the submerged speed showed a slight increase of one knot, from 10½ to 11½ knots, and there was a jump of six knots in surface speed, from 14 to 20 knots. The radius of action was extended from 2,300 to 3,000 miles.

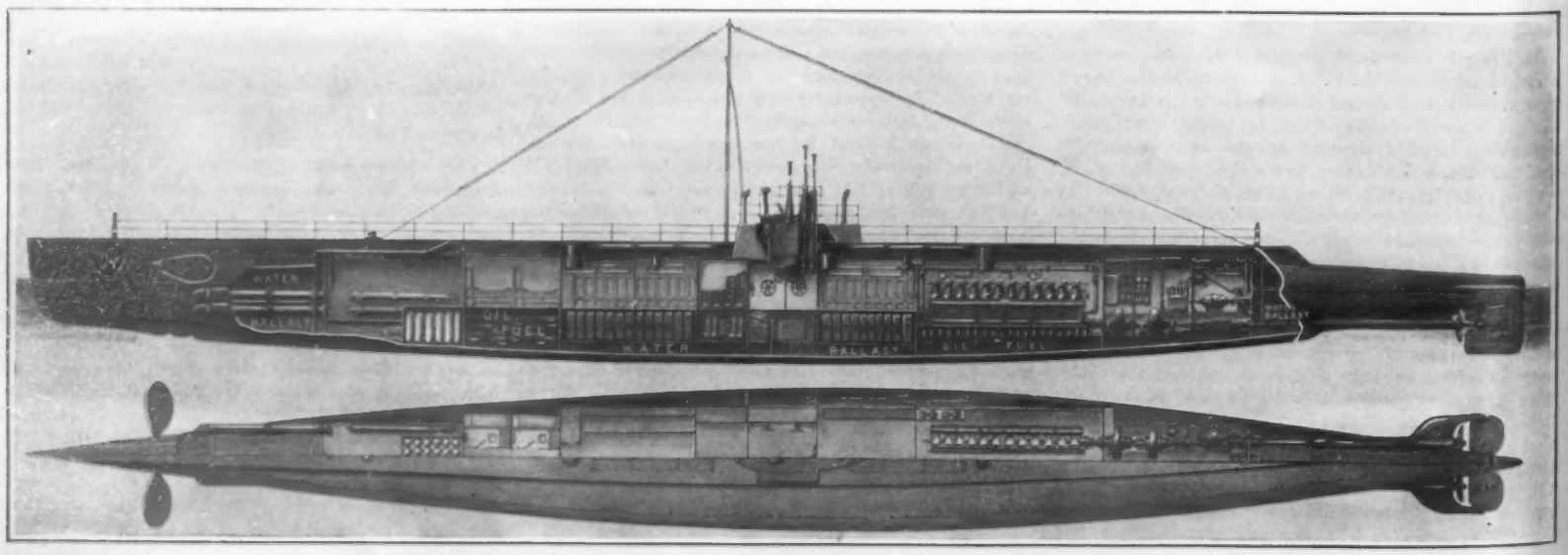



**Development of the Holland submarine from 1895 to 1915**

Now the full story of this development is not to be measured in these mere tabulated figures, for there has been a proportionate increase in habitability, in ease and certainty of control, in safety, in the range, reliability and power of the torpedo armament, and above all in the ability to keep to high seas independently of wind, weather, and the immediate proximity of a submarine base.

The public has heard a good deal lately about the respective merits of the coast-defense and the sea-going or fleet submarine. Referring to our historical diagram, it may be said that all of the types preceding and including the 676-ton boat of 1913, belong to the coast-defense class, and this for the reason that they are not large enough, cannot carry sufficient supplies, and have not sufficiently comfortable crew accommodations, to operate with the main battleship fleet out on the high seas, and take everything that may come along in the way of bad weather. The great majority of our sea-going officers believe that the essential qualifications for the fleet submarine cannot be included in a vessel of less size than the 913-ton type of the year 1913. This vessel displaces about 800 tons on the surface and it is therefore of about the same size as the larger German submarines which have done such effective work during the present war.

The big vessel of 1915, displacing over 1,200 tons at the surface, and over 1,400 tons submerged, is the fleet submarine "Schley," an experimental type which is now under construction for our navy. As will be seen by a comparison with the type of 1913, the "Schley," is of the same general type, with enlarged dimensions and an increase of three knots in the surface speed.




*Length*, 263 ft. 9 in. *Submerged displacement*, 1454 tons. *Surface speed*, 20 knots. *Submerged speed*, 11½ knots.

**The 1250-ton (surface displacement) "Schley" now building for the Navy**

| Date of Design | Length Over All | Displacement Submerged | Surface Speed | Maximum Speed Submerged | Radius at Cruising Speed |
|---|---|---|---|---|---|
| 1895 | 53' 3" | 73 tons | 6 | 5 | 200 |
| 1900 | 64' 0" | 122 tons | 8 | 7 | 490 |
| 1905 | 82' 5" | 170 tons | 8¾ | 8 | 850 |
| 1907 | 105' 3" | 273 tons | 10½ | 9 | 900 |
| 1907 | 134' 10" | 337 tons | 13 | 9½ | 1,240 |
| 1909 | 135' 3" | 340 tons | 13½ | 11 | 2,475 |
| 1909 | 144' 2" | 400 tons | 14 | 11¼ | 2,350 |
| 1910 | 147' 3" | 434 tons | 14 | 10½ | 2,300 |
| 1911 | 153' 6" | 480 tons | 14 | 10½ | 3,150 |
| 1913 | 167' 5" | 548 tons | 14 | 10½ | 3,150 |
| 1913 | 196' 3" | 676 tons | 14 | 10½ | 2,400 |
| 1913 | 230' 6" | 913 tons | 17 | 12 | 3,000 |
| 1915 | 263' 9" | 1,454 tons | 20 | 11½ | 3,000 |

The submergence of the "Schley" is accomplished by the filling of water tanks, and the operation of two pairs of horizontal or diving rudders, one pair at the bow and the other at the stern. The hull is divided longitudinally into nine main watertight compartments. Forward at the bow are the water ballast tanks through which are carried four torpedo-discharge tubes, two on the port and two on the starboard bow. Aft of this is the torpedo compartment. The next compartment forms the officers' quarters, and aft of this come the crew's quarters with storage batteries below deck. Then follows a smaller compartment, the upper part of which is the wireless operator's room and the lower half is given up to cold storage. Next, at about the midlength of the boat, is the central operating compartment with the conning tower and bridge above. There are the three periscopes, two of which lead down into the operating room, while the third terminates in the conning tower. Aft of this, comes another compartment, containing quarters for the crew, and below the floor, as in the case of the other crew's quarters, are storage batteries.

Then follows the engine room containing two 12-cylinder engines, capable of driving the ship on the sur-

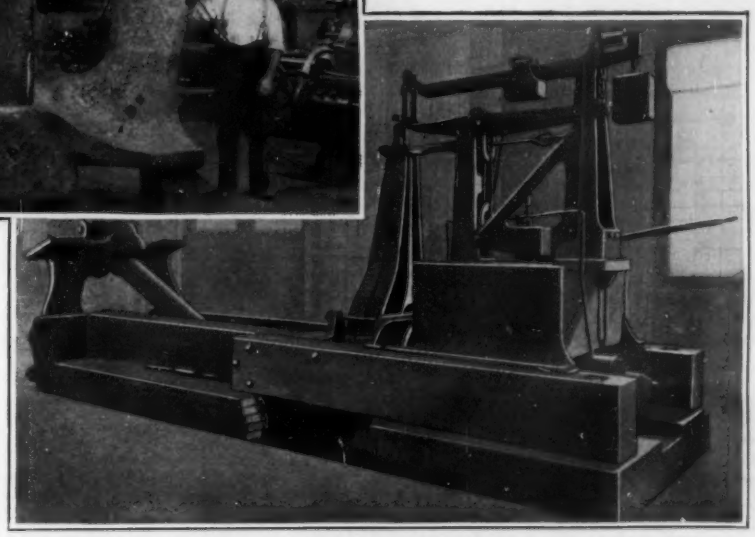
(Concluded on page 332)

## The Largest Anchor and How It Is Tested

THE largest anchor ever made is shown by the illustration. Its weight is ten tons and it is used to anchor the largest dreadnoughts now in the United States Navy, this one having been made for the superdreadnought "Pennsylvania." If the dreadnought continues to grow, it is hard to say what the size of the anchor will be. If much larger than this one, they will be difficult to handle after they are made and put together. The largest previous anchor to this one was one of 18,500 pounds. This particular type is known as the Baldt anchor from the name of the designer and inventor. Smaller anchors of this and other types are used widely on both Government, merchant and foreign vessels, the smallest weighing about 200 pounds. The earlier American battleships and cruisers have anchors weighing from 8,500 to 16,500 pounds each.

The anchor's design is simple, for it is built on the ball and socket principle with no pins to break or bend. Many anchors are hinged on a pin which sometimes rust out quickly or become structurally weak, for in time the shank shears off the pin and pulls through the head. The fluke or main portion of the anchor is in one piece while the shank itself has an end like a ball working in a socket which holds it firmly and gives it mobility.

Such anchors are made of the best quality of plain cast steel and are carefully and thoroughly annealed. The United States Government inspectors make careful tests of the strength of the steel, and each part of the anchor is dropped from a stipulated height and hammered with a heavy hammer to detect any cracks or other defects that may have developed. Anchors to be used on vessels built under the rules and supervision of the American Bureau of Shipping or under Lloyd's Register (British) must all be tested in a specially designed anchor testing machine. We show one of the largest of these. The test consists in placing the anchor in the machine in the position indicated. A definite pull is exerted on the anchor's shank, just as when in use, the amount of tension depending on the anchor's size and the Bureau's requirements. The beam of the machine registers the pounds of tension and when the required pull has been exerted, the beam rises. If no flaws or defects develop, the anchor is accepted.



**Rough casting for the world's largest anchor and (below) standard machine for testing the strength of the flukes**

## A Baby Tractor of Great Power

A TRACTOR embodying many novel and remarkable features of divergence from the accepted design and one that is probably the smallest of the small, low built class of orchard tractors is the machine illustrated herewith, invented and built by a California orchard owner.

Orchard work presents the most difficult sphere of tractor activity. First of all an orchard tractor must be hung low to pass under the branches. This means that traction difficulties are met on account of the small wheels required; in spite of the various types of grousers employed, these quickly bury themselves if the ground is loose or soft. In addition, California orchards are periodically irrigated, so that the use of the ordinary tractor for cultivating is impossible for various intervals of time, on account of the wet ground packing under the machine's weight.

With this new model the ground may be worked as soon as it is in condition, without any packing. The long U-shaped prongs or grousers simply penetrate the ground to the harder subsoil, and in coming out break it up instead of packing it. And on account of these prongs being offset from the face of the wheel it is impossible to choke the wheel up with the sticky mud; there is no backing to hold this.

As an instance of the cross-country ability of this machine, it was put to work in ground where a crawler or caterpillar type would cross, but could pull no load, the tracks sinking in three or four inches. But the new model pulled a two-bottom ten-inch plow through this ground without the least indication of depressing it. Of course this was only a stunt; plowing ground in this condition would be quite absurd. In the same spirit the machine was driven at a gravel pile three feet high, negotiating it without difficulty.

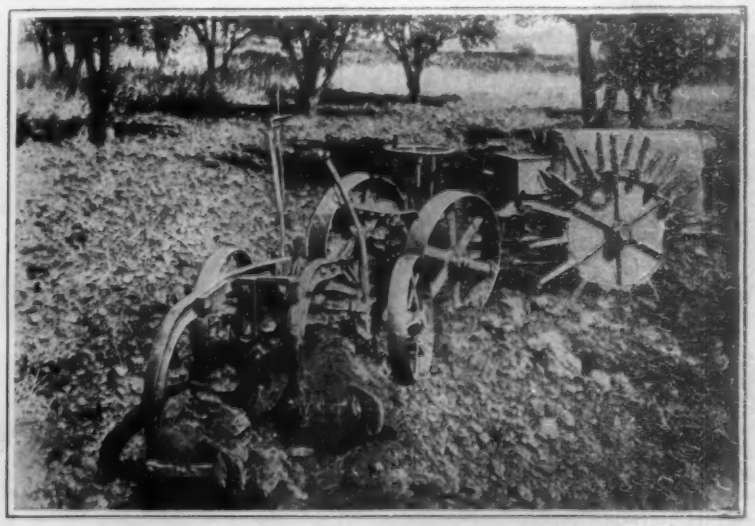
Another peculiarity of orchard work is the manner of plowing. To keep the ground level, the orchardist plows one year to the trees, the next year from the trees. In the latter case, low branches, the difficulty of maneuvering the tractor around the trees, and the inability to get the plow close enough to the tree without causing undue side-draft upon the tractor, impel most owners to abandon the tractor and, as the only satisfactory solution, to plow with a single horse. The narrow width of the new tractor, however, permits a center hitch for the plow, enabling it, regardless of the direction of plowing, to get right up to the trunk of the tree without any side draft at all. In manipulation about the tree base this tractor is as flexible as a single horse; in fact, tractor and plow will turn in a 7-foot radius.

Interesting features of the construction of this machine are the enclosed bearings, dust-proof and running in oil or grease. Freedom from grease cups and from the wear and tear of the excessive dust of orchard work upon exposed bearings effect a rare combination of advantages. An ingenious band is furnished to go over the lugs on the driving wheels, so that with ten minutes light work the tractor can be put in shape for road driving.

The entire machine weighs 1,750 pounds, and develops about five horse-power on the draw bar. Transmission gears run in oil and are enclosed. The final drive is by internal gear; the pinion and the removable bull-gear are accurately centered in the drive wheel to prevent any side strain on the axle. The tractor has a speed of about two miles per hour, which makes possible the plowing of about four acres per day with a fuel consumption of a gallon per acre.

The remarkable lugs of this model, affording traction without weight or packing in all kinds of ground, are revolutionary in tractor design, and should prove very attractive to the small farmer.

**Some idea of the size of the baby orchard tractor may be had from this picture**



**New orchard tractor and the sort of ground it has to work in**

# Strategic Moves of the War—March 22d, 1917

By Our Military Expert

HISTORY has been made in this last week and the influence of its events will be felt probably for many years and in many countries. It would seem that Shakespeare's warning—"The Ides of March remember"—is applicable to many nations and individuals of the present day if the happenings of this week are to be considered.

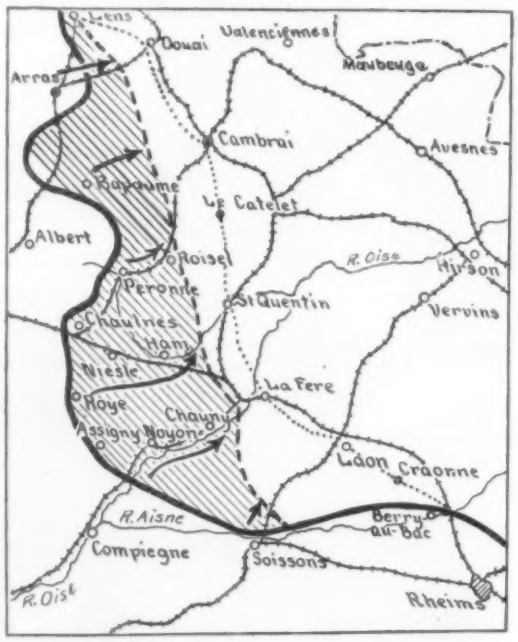
Russia has become in a way a constitutional monarchy, perhaps ultimately to be a republic. Bagdad has been taken and everything now points to the early capture of all the Turkish troops operating in Mesopotamia, Persia and eastern Armenia; the "U" boat war from which so much was expected by Germany has practically failed; and the German forces have evacuated a large portion of northeastern France that has been occupied by them for two years or more.

No one can now predict what is to happen in any of the theatres of war; how far the Germans will withdraw in France and Belgium can so far only be surmised. The successive captures by the British of so many commanding positions to the north and east, west and southwest of Bapaume left little doubt of the final capture of that German stronghold; it fell into British hands on March 17th together with many villages in the vicinity. At the same time the strong advance farther south of the French troops over a front of fifteen or more miles forced the Germans to abandon all their fortified lines from Andéchy, northwest of Roye, to the region of Lassigny below the Avre River. Pushing forward with great speed the French occupied the town of Roye close upon the heels of the retiring Germans while the British on the immediate north beginning at Fresnes and extending nearly to Arras swept the country clean of opponents. By leaving behind machine gun detachments and squads of picked men to hold back the pursuers, the German forces were enabled to make their retirement in good order over the whole front practically from Arras to Soissons. Continuing their advance despite limited resistance and bad weather, the latest reports show that the important towns of Ham and Chauny and the entire line from the Aillette River front to Soissons with many villages are in the possession of the French. Chauny is about six miles from La Fère and nearly twelve miles beyond Noyon. French cavalry are also at Roupy about four miles from St. Quentin and so far opposition has not been able to stop their advance.

Farther north the British troops have extended their own lines running from Beaurains near Arras in a southeasterly direction through St. Leger, Léchelle and Péronne to the neighborhood of Ham which is already in possession of the French, who have also taken without resistance Tergnier, an important railway junction less than three miles from La Fère. From Tergnier three railroads branch—one east to La Fère, one southwest to Noyon, and one northwest to St. Quentin. Standing as the Allies do at present on a line eighty to one hundred miles of front, after having recovered many hundreds of square miles of territory so long held by the enemy, it can be but a question of hours when it will be decided whether a stop by the retreating foe will be made on the Hindenburg line extending practically from Lens through or in front of Cambrai, Le Catelet, St. Quentin, La Fère, Laon, Craonne to Rheims. At the present writing the French are no doubt immediately in front of La Fère and St. Quentin. Both of these towns belong to what is the second German line; if either falls then the German retreat must go beyond Laon and will reach the French-Belgian frontier, extending from Ypres or Lille through Valenciennes and along the railroad from that city through Le Quesnoy, Avesnes to Hirson and perhaps to Mézières on the Meuse River. So far at least the retreat seems a success in a military point of view, as few prisoners or stores have been taken during the pursuit. Full credit must be given the German commanders for having been so skillful in their withdrawal.

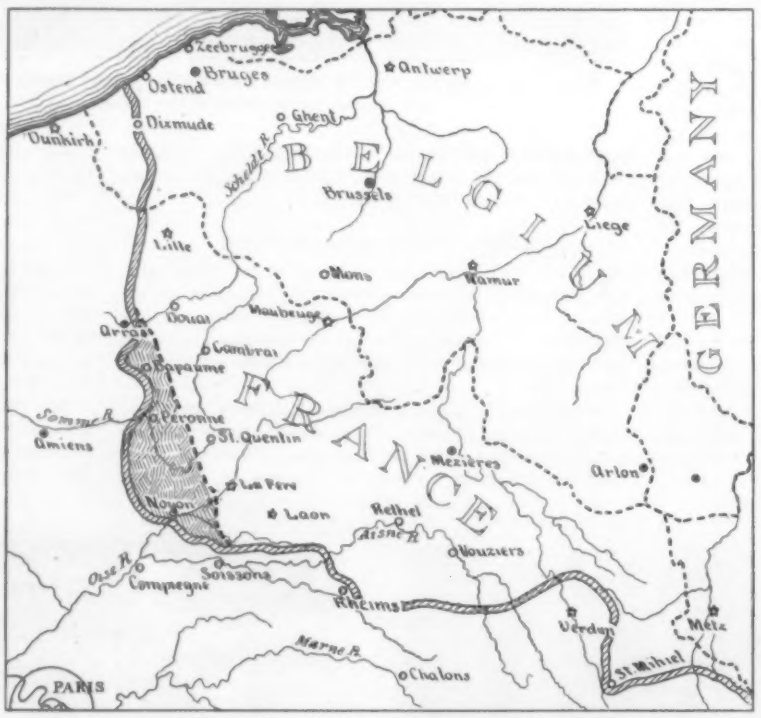
At two points on the old front no great success up to the present time has been obtained; the one where a British force is operating against the Arras section, the other where a French army is moving towards Laon. As long as these two sections are held, it will be evident that the German commander is only straightening his line from Arras to Laon, the principal defense of the latter town being made in the hills and forests of St. Gobain between Chauny, La Fère and Laon; otherwise the breaking at any point of the Cambrai-Laon line by the Allies will require an immediate retirement on a front possibly as great as from Lille to Rheims. The great importance of Cambrai is that it is the principal barrier between the Allies and the great French coal and iron fields around Valenciennes twenty miles to the north. These fields have been in the possession of the Germans since their first rush through Belgium in 1914.

It is all a matter of speculation or guesswork; only further developments will show what are the intentions of the German leaders. If the Germans go to the frontier in their retreat, they will shorten their lines by eighty or one hundred miles; they can free from two hundred and fifty to five hundred thousand men for offensive operations and can force the Allies to stop their advance until railroads and other means of communication are constructed. It may be that von Hindenburg intends, after straightening his front, to make some strong strategic and smashing attack upon some other part of the Allied lines. The suggestion has even been made that this might happen in a blow along the Belgian or English front in an attempt to reach Calais. But the latest advices indicate that the German withdrawal will extend into the region north of Arras and inside Belgian territory as their troops seem to be developing great activity north of La Bassée and along the Belgian lines. The same patrol watchfulness and service that preceded the retreat on the southern front are now noticeable north of Arras and around La Bassée. Where all this will end will be known, however, in a few hours, or at least days, for the pressure of the French and English is continuous, and must soon bear fruit.




**Territory recovered by the German retirement**

The black line represents the battle front before the surrender began and the broken line indicates the battle front on March 22d. The dotted line is the so-called "Hindenburg line."




**Relation of the recovered territory to the rest of the battle front**

It is almost amusing to read some of the criticisms and claims of some high German military authority in Berlin, who excuses the withdrawal with some remarkable statements, reasons and logic. In a long interview given to the press, he states that: "There is no particular military significance attached to any especial section of the enemy's territory—we are now getting the enemy out of their trenches." He then expatiates upon new positions that have been carefully prepared back of the old front and that have been built with every possible device that experience has shown to be useful. Exactly why the German Army will take up a new intrenched position and why the Allies cannot do the same thing does not appear very clear to a casual onlooker. The facts appear to be that the retreat has been forced for many reasons—the overwhelming superiority of the Allies in men and munitions, the evident deterioration in the fighting capacity of the rank and file of the German Army due to losses in three years of war, the lack of food, clothing and most probably of gun ammunition.

These deficiencies will undoubtedly become more evident as this year's fighting goes on and can lead to but one end. That end becomes more evident when the recent happenings in Russia are considered. Ever since the war began, murmurs of conditions and happenings in that country have reached the outside world; but it is thought few if any believed it possible that the ruling powers could be overturned and German influence in Russia destroyed almost at a blow. Such is now the case and Germany finds herself opposed by a united Russian people and Russian Army that will both be heard from this spring. The "switchboard from Petrograd to Berlin," that General Brussiloff so openly proclaimed as existing is now destroyed, and the various Russian armies will go forward without fear of traitors at the rear. The continuance of winter weather on the eastern front has so far permitted no extensive military movements; with accumulations of men and munitions during the winter months the armies will find themselves able to advance, though it is hardly probable that such an initial success is to be looked for as attended General Brussiloff's Galician campaign dur-

(Concluded on page 333)

# Correspondence

*(The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.)*

## The United States and the Starvation of England

To the Editor of the SCIENTIFIC AMERICAN:

In view of the fact that 470 Allied and Neutral ships were sunk by the Germans in the three months preceding February 1st and the statement attributed to German sources that they have 300 submarines afloat and 1,000 on the stocks, the threat of the German starvation of England is not wholly incredible, and the possible effect upon the United States of such an eventuality becomes a subject of practical consideration.

Irrespective of any overt act, this reflection suggests the practical certainty that the United States will be drawn into the war to protect the lives and property of its citizens against unlawful and piratical attacks by the Germans. Whether we like to admit the fact or not, it is true that our foreign policy for many years has been based on the reality that the English fleet has been our chief dependence for the protection of our Atlantic Coast and coast cities. Hence any attack on the British Isles that seriously threatens their naval supremacy will force us to come to the defense of England. The most fundamental reality of the situation is the fact that we cannot successfully defend our own coasts and the rights of our seamen and shipowners, without lending our support to the Allies, either on the seas or on the continent of Europe.

The newspapers tell us that the German General Staff figures that the destruction of one million tons of shipping a month will soon bring England to terms. This is a rough estimate, but the fact that England is supposed to possess only twenty million tons afloat, of which about one half has been commandeered for war purposes, makes the total seem reasonable. Whenever the available tonnage falls below the danger point for England, the United States must come to her support or else completely reshape her foreign policy.

The total tonnage in the United States in 1914 was 7,928,688 tons; but of this tonnage considerable part was confined to inland waterways. There has been a large addition to this tonnage during the past two years, but it is doubtful whether we now have five million tons immediately available for transatlantic trade. It would thus appear that the German estimate would use up the available tonnage of Great Britain and the United States in little more than a year's time.

Our ship-building plants on the coast are working at full capacity to increase this tonnage; but the naval programs for the last two years, with their large tonnage of capital ships, must act as a handicap on eastern builders in their effort further to enlarge the American merchant fleet. Undoubtedly, Germany took account of this when she challenged us to fight for our rights on the seas. Great Britain has realized the danger and has already contracted for fifty cargo boats of standardized design, each of about nine thousand tons dead weight. But Germany has also taken account, we may be sure, of England's building capacity in making her plans. and any reinforcement we can bring to Great Britain's building program would be of great value at the present time.

In this connection it is worth while calling attention to the fact that on June 30th, 1914 we had on the Great Lakes 2,339 steam vessels with a tonnage of 2,523,517 tons. During the next fiscal year we built 131 vessels, aggregating 56,549 tons. The following year probably added a similar amount to the tonnage on the lakes. Most of these vessels are too large to pass through the Welland or St. Lawrence Canals. But about ten years ago a large ship-building company at Bay City accepted a contract for several steamers of great capacity for the Atlantic trade and built these steamers at their yards at Bay City. They cut them in two, taking out the rivets from the plates, and built special temporary bulkheads to enable them to float the separate sections to tidewater on the St. Lawrence River, where the sections were reassembled and the vessels finished for use in the Atlantic trade. The same thing might be done with a large number of the vessels now in port on the upper lakes, and with proper dispatch a very extensive reinforcement might be made to the American Atlantic merchant fleet soon after the opening of navigation on the lakes, which occurs about the first of April. Probably a sufficient number of ship owners on the coast could not be induced to undertake this expense for their personal profit, but a considerable proportion of the fifty millions appropriated by Congress to establish a government owned merchant fleet might very profitably be invested in the purchase of a large number of these vessels, cutting them apart, transferring them to the Atlantic, and re-building them for transatlantic service. In this way the government might come to the support of Great Britain at a moment when such action would be very valuable to the nation whose fleet now stands between us and Germany.

Thus far the government at Washington has not indicated on what lines the possible coming war would be waged and what its immediate and ultimate objects would be. The logic of the situation must convince us that the immediate purpose of the war, if war is to follow, would be the protection of American seamen and ship owners; and this can be accomplished only through the support of the Allies, particularly the British, in their warfare against Germany.

From Mr. Wilson's previous utterances, it may be fairly assumed that the ultimate object of the war would be the establishment of a peace in Europe and on the high seas that would carry out the idealistic purposes of the President as announced in his address to the Senate January 22d. This must depend, however, on the cooperation of the Allies, whose plans must have weight in proportion to their previous sacrifices. It is unfortunate, from a practical point of view, that the President decided not to use the ninety-five German ships interned in our harbors, with their 600,000 total tonnage; but if the Germans had been familiar with Mr. Wilson's peculiar idealism they might have saved themselves the trouble of dismantling the engines of their ships, since it is entirely obvious that the President would submit to a defeat rather than make use of the advantage which the possession of these vessels might give to the United States. The practical reinforcement these vessels would have given our fleet counts for nothing with the President's chivalrous temperament. No similar objection can be raised to the use of vessels from the Great Lakes, and it is hoped that the authorities at Washington will see the advantage of availing themselves of this splendid reinforcement at a time when its value would be most felt.

In addition to the fleet of grain and ore carriers now on the upper lakes, the government should not fail to make use of the several fine ship-building companies located at Buffalo, Cleveland, Toledo, Wyandotte, Detroit, Bay City, and Chicago. These ship-building concerns might easily be pressed into service in the manufacture of small swift cruisers and patrol boats for protecting and convoying American merchant vessels through the danger zones of the eastern Atlantic and the Mediterranean. Immediate use for this purpose should of course be made of steam yachts and power boats on the Atlantic Coast and their numbers might be rapidly reinforced by using the facilities of the ship-building companies mentioned above.

WILLIAM W. HUDSON.

Indianapolis, Ind.

## A Way to Have a Reserve Army That Would Be Popular

To the Editor of the SCIENTIFIC AMERICAN:

The conclusion is apparent to all fair minded thinkers, that there is not enough patriotism among our people to provide by enlistment for either a standing army or a National Guard. It is apparent also that conscription is unpopular and difficult. With Americans, idle soldiering is regarded with repugnance if not contempt. I would suggest this plan for consideration of statesmen and military experts.

Enact a law whereby all abled bodied males, between the age of 18 and 26 years, may enlist in an auxiliary army, not to exceed in number 100,000 for any State containing a million or more inhabitants—those States with less in proportion. Enlistment to be for service of from one to three years, with right to resign in peace time any time after one year's service. Provide a wage for these soldiers of one dollar a day (except Sundays) and compensation for any injury during service, and something to his family in case of death. Also clothe, feed and equip them as regulars. Require these reserves to drill and undergo military training one half of the time (Sundays excepted), and on the other days, engage them in building public highways and bridges. A detail to build the roads, alternately with military drilling and practice with arms. All soldiers must be hardened to stand trench work, and they may thus be made useful, and a blessing to the country in time of peace, and a guarantee against war.

By this scheme, in ten years a vast army of trained men could be called out in any emergency, and the country would be interlaced with great commercial highways, and agriculture and trade developed, and splendid roads would exist everywhere for our travelers' enjoyment.

The expense will be great; however, it could be provided for in this way. The Government could issue small interest bearing bonds to run for a long time, to be sold in blocks in reach of small investors, and a wheel tax could be imposed to pay the interest on these bonds, which should be payable semi-annually. The Government could also require each State to provide for the material used in bridges and surface paving, and levy a direct tax against each State for that used in such State, leaving the States to get it by some equitable tax.

If you will estimate the benefit to accrue to the country, you will find such benefits outweigh the costs. Space forbids more details. The great amount of ready money circulated by the pay-roll of these soldiers in all of our rural districts will advance a much needed cash circulation in all seasons, and relieve from the curse of tight money these rural districts. This cash circulation will ward off misery in our war-made money panics, and these good roads will relieve, by bringing producers in easy reach of the market, the high cost of necessities. In every way the plan will make for industrial peace and prosperity. I have conferred with farmers and workmen, and while the profit of the plan is small to the soldier, yet with the natural love of youth for things military and the enthusiasm for good roads, it is believed there will be little worry in getting sufficient volunteers all of the time.

J. M. GIBSON.

Houston, Texas.

## Muzzle Velocities

To the Editor of the SCIENTIFIC AMERICAN:

In the SCIENTIFIC AMERICAN for January 13th, in the article "Simple Methods of Determining Rifle Muzzle Velocities," the two "non-classical" methods suggested appear to me to have some difficulties.

In the "heat method," how is the water to stay in the pot after several bullets have been fired into it? Are bullets to penetrate only partly through the steel shell? Again, if bullets deform, as they would be likely to do if stopped by this vessel, how would the energy thus lost be figured? How much stirring would be done, supposing water to stay in the pot? How would heat added by stirring and heat lost by radiation be figured?

In the "gravity drop" method, how would the amount of bullet deflection by vibration of barrel, small differences in bands and grooves at muzzle, etc., be calculated? This is one of the chief reasons why a string of bullets fired from a rifle held in fixed position do not all go through a single hole in the target, but form a group of holes. Wonderfully precise measurements would have to be made in any event, since the difference in fall would be extremely slight for any distance like one hundred yards.

This may explain why the writer of the article has never heard of his suggested methods being used.

C. G. YOUNG.

## Reflections on Road Making

To the Editor of the SCIENTIFIC AMERICAN:

I wonder whether my letter in the SCIENTIFIC AMERICAN of December 3d, 1892, had much or anything to do with promoting the now common practice of oiling the prairie roads of Illinois. Surely, with a few years more of proper care these will be the best roads in the world for the money. Think of a road equal to an asphalt pavement at a cost sometimes as low as two hundred and fifty dollars per mile! Oil is needed each year for two or three years until the surface is thoroughly waterproof, and constant care must be exercised to keep the surface dragged or graded so that the water may run off; but this is all.

I am not yet calling for all broad wheels. There are good reasons against broad tires, as well as for them. Not only is a wide tire liable to slide sideways, but it does not look well; and looks count, sometimes.

And I wonder whether clay from the roadside cannot be burned or vitrified and placed in position by a big portable machine and furnace combined, at less cost for the completed road than that of broken rock or paving brick placed in the usual way. A properly constructed machine would surely do the work in an economical, expeditious and thorough manner, after the experimental stage was past.

J. A. CUNNINGHAM.

Virginia, Ill.

## Anti-Submarine Device

To the Editor of the SCIENTIFIC AMERICAN:

In view of the great destruction of shipping by submarines using torpedoes I want to suggest a means of defense. So far I have not seen any account of its having been used or tried.

Let each ship be equipped with steel plates to be hung over side instead of the old-fashioned nets, these steel plates to be of sufficient size and thickness to explode any oncoming torpedo.

If the wave action affected a single plate too much, then hang them double—a 5-foot plate over a 10-foot for a vessel drawing 15 feet of water.

The object of this would be to leave the upper and smaller plate free to swing with the wave action.

Plates to be swung far enough away from the sides of the vessel to save the same from effects of exploding torpedoes.

I venture to suggest that submarines would soon lose most of their terrors if all merchant vessels were so equipped as well as being furnished with a proper number of rapid-fire cannon, large enough to sink any submarine that showed itself.

GATES M. FOWLE.

Los Angeles, Cal.

Outcrop of massive bituminous sand with light overburden. For scale of dimensions note the man in the foreground

Outcrop of bituminous sand 155 feet thick and 5,800 feet long, representing many millions of tons of material

# The Birth of a New Industry

## Vast Canadian Deposits of Asphaltic Sand and How They May Be Developed

DURING a recent visit to the laboratories of the Mellon Institute of Industrial Research at Pittsburgh, Pa., the writer was much impressed by an investigation now being conducted with a view to determining in a practical manner the possible commercial value of bituminous or asphaltic sand.

Since the first explorer descended the Athabaska River, upwards of 150 years ago, the existence, in the northern part of the Province of Alberta, of deposits of asphaltic or bituminous sand has been recognized. This material consists of approximately 15 per cent of high grade bitumen and 85 per cent of silicious sand. That the deposits were of large extent was evident, but, until quite recently, little was definitely known regarding their true economic importance.

For many years, the remote geographical position of the deposits, as well as lack of transportation facilities, effectually prohibited any attempt at actual development. Apart from widely scattered fur trading posts, there was an entire absence of settlements throughout great tracts of Northwestern Canada Methods of transportation were of the most primitive sort—dogs and toboggans in winter, scows and canoes in summer. Gradually, however, with the opening up of the country, conditions have changed. New railroads and highways have been built and settlements have come into existence.

The old historic fur-trading post of Fort McMurray, 300 miles to the north of the city of Edmonton, stands near the southern border of the bituminous sand area. During the past two years, a railway, known as the Alberta and Great Waterways, has been under construction between Edmonton and Fort McMurray, and, with the early completion of this road, the last serious hindrance to the actual development of the great asphaltic deposits will have been removed.

Three outstanding features presented by a consideration of these deposits may be stated:

(1) They represent the largest known deposits of solid asphaltic material;

(2) The deposits are as yet totally undeveloped;

(3) At the present time every ton of asphalt used in Canada is imported from foreign countries

The areal extent of the deposits is probably not less than one thousand square miles and the average thickness is upwards of 100 feet. With adequate markets and transportation facilities, there seems reason to believe that within the next five years important development may be expected.

Recently, the Mines Branch of the Canadian Department of Mines has undertaken an investigation not only of the deposits themselves, but also of methods best adapted to the commercial treatment of the crude bituminous sand. As a result of this work, there appear to be three possible commercial applications for the material from these deposits:

(1) The use of the bituminous sand in a more or less crude form in the surfacing of streets and highways Experimental pavements recently constructed in the City of Edmonton, Alberta, indicate that the material is well adapted for such uses.

(2) To separate the asphalt or bitumen from the crude material in order to derive a more or less pure product. The actual commercial applications of this product are as yet not definitely determined, but it should be well adapted for paving purposes, as well as suitable for the manufacture of certain varieties of paints, varnishes, roofing preparations, etc.

(3) To destructively distil the crude bituminous sand for the purpose of obtaining crude petroleum therefrom. Considering the absence of developed petroleum fields of commercial importance in Canada, such distillation could be undertaken under exceptionally favorable conditions

A study of possible separation and distillation methods is being made at the Mellon Institute of Industrial

Where men lose their canoe through a mishap they must return to the primitive raft

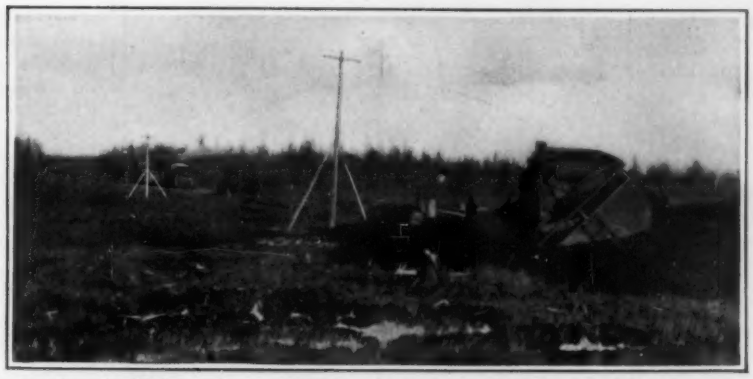
All travel up the river depends on the tracking or towing line

The footing for the trackers is often pre arious

Research in Pittsburgh. Mr. S. C. Ells, of the Mines Branch of the Canadian Department of Mines, is Industrial Fellow in charge of the investigation.

He has developed a process for economically effecting the separation. No information relating to this method is, at the present time, available, but suffice it to state here that the asphalt may be satisfactorily recovered by heating the bituminous sand, in water under pressure. It is difficult to eliminate the fine sand above 200 mesh, but such a procedure answers for most purposes.

It is of interest to note that practically the entire area of bituminous sand is at present held under Government reserve. There is reason to believe, however, that, within a reasonable time, this reserve will be removed and provision made whereby private individuals or companies may acquire areas for developmental purposes. The future development of these deposits will be awaited with the interest that their great extent appears to warrant.



**A railroad will shortly be completed as far as the asphalt deposit at McMurray. The illustration shows one of the difficulties met with in building across the great peat bogs of the North**

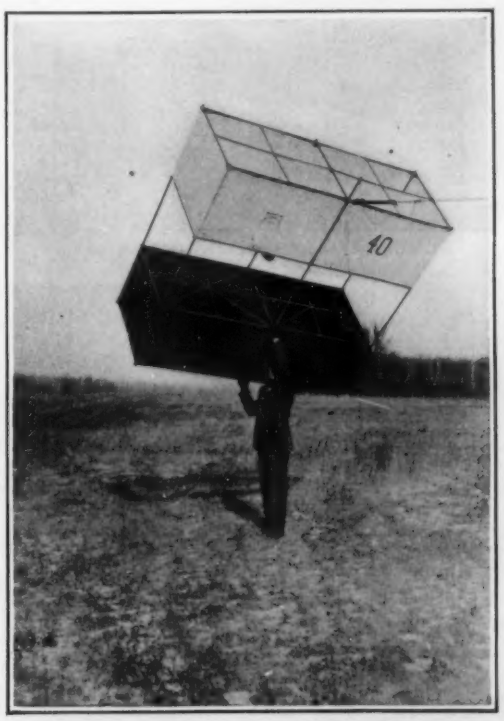
## Flying Kites to Study Weather

EVERYONE has heard of Ben Franklin and his kite, but few know that today a group of men out on the Nebraska prairies are still flying kites, making discoveries which may in time become quite as famed as Franklin's historical achievement. These men are professional kite fliers, belonging to the aerological division of the United States Weather Bureau. They spend their entire time on an isolated farm, studying the upper atmosphere by means of kites. On this forty-acre farm, five miles from the little towns of Elkhorn and Washington, Neb., the weather bureau is now carrying out meteorological investigations, seeking to discover the mysteries of the storms that hover over us, the insidious winds and air currents—in short, the secrets of weather. Aviation also has brought with it a greater necessity for knowledge of the upper air and the army finds an acquaintance with the caprices of the wind invaluable in artillery firing. So anyone of the seven men who work days and often nights even in the coldest weather will tell you that kite flying today offers an opportunity to make some of the most useful discoveries

This station, the only one of its kind in this country, has just celebrated its first birthday. Although as early as 1898 the weather bureau conducted some kite flying experiments in various parts of the country and for about eight years maintained a station at Mount Weather, near Washington, D. C., the work was never considered quite satisfactory. In the case of Mount Weather, the proximity of the site to the ocean and the elevation were not conducive to results which would be typical of a large part of the country. So in 1915 the government moved its entire plant to a site about eighteen miles due west of Omaha, where since December 1, 1915, regular daily flights have been made. The advantage in the present location lies in the fact that it is well in the path of all storms crossing the country. It was also the intention to make use of the army balloon plant at Omaha in sending up sounding balloons to explore higher levels than would be possible with kites, but, unfortunately, the war has cut off the supply of suitable balloons and very little of this work has been carried on.

One who desires a good idea of the aerological station should picture to himself a modest farm house, a neat granary and a stable, the whole surrounded by a clump of trees and off at one side a huge open field. The farm house serves as the headquarters of the station and furnishes the men with living accommodations. The granary has been transformed into a kite shop, but from its modest exterior one would never guess that the inside boasted an electric power plant, a laboratory, a kite factory and forty or more kites, piled high on both floors.

They are huge affairs, bearing little resemblance to the kites of boyhood days. All are of the box style, most of them 7, 8 and 9 feet square, and 2 feet 8 inches deep, designed by Hargrave, an Australian, and perfected by Prof. C. F. Marvin, chief of the weather bureau. They have a foundation of forty-one Oregon spruce sticks, carefully lashed together with coarse, waxed thread. The kite frame is braced by fifty fine piano wires running diagonally through it. One end of the kite is covered with black umbrella material and the other end with white cambric. The black part can be seen in the white clouds and the white part in the dark clouds and thus the observer can always keep his eye on the kite. The larger kites are reserved for light winds, while the smaller aircraft are for use when the atmosphere is turbulent. The average-size kite weighs about nine pounds.




**Landing a kite. The double coloring makes it equally visible against dark clouds and light**

Out near the center of the forty-acre field is the reel house, a little, round building mounted on a turntable. In the doorway is the reel, propelled by an electric motor and used to haul the kites down. Since they fly two or three miles high and as many as ten or twelve may be fastened on the same wire, the convenience of the reel is easily apparent. Fine piano wire is used to fly the kites. Whenever it is desired to send them up the reel house is turned so that the entrance is on the leeward side of the house and the wire is then unreeled out of the door.

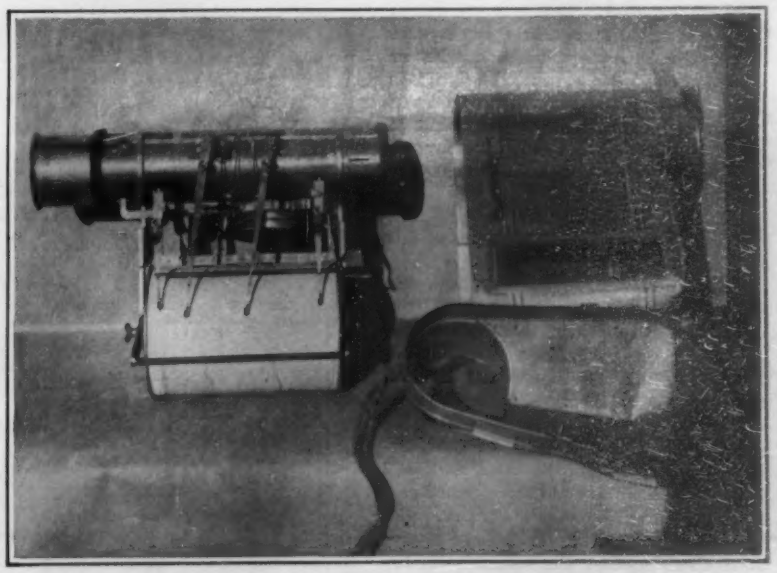
The first kite on the wire bears a little instrument called a meteorograph, which is fitted to one of the braces inside the kite. It is this instrument which records conditions in the upper atmosphere. It runs by clockwork in much the same way as larger instruments of the kind and with four delicate steel fountain-pens marks on a sheet of cross-section paper the wind velocity, temperature, barometric pressure and humidity for the entire time that a kite is in the air. Often the operator may desire to know how high his kite is flying. This he does by means of a theodolite, resembling the surveyor's instrument. He figures out the angle of the kite string and then from the amount of wire out, as registered by the reel, he computes the vertical distance of the kite above the ground. Besides the first kite carrying the meteorograph, other kites are attached to the wire at intervals, the number depending on the wind velocity and length of line. Their purpose is to support the wire.

Flying kites is not the pleasant pastime that might be supposed. To be an expert in this line requires, probably most of all, a good sporting instinct. A kite flight generally lasts about four hours and it is the plan of Mr. B. J. Sherry, who is actively in charge of the station, to make one flight every day that there is sufficient wind, regardless of the weather. Twice a month a thirty-six hour period is set aside, when nine flights are made continuously night and day. It is often very cold work; during one of these thirty-six hour periods the thermometer did not go above zero even in the day time. Consequently the sportsmanship of the men may be sorely tried at times.

To prevent life at the station from becoming too monotonous the kites occasionally break away and go flying over the country, trailing the wire behind. That naturally would make serious trouble for telegraph companies if the kite wire became tangled up with their lines, and in order to minimize that possibility as far as possible, the station was located five miles from the nearest railroad. In case a trailing kite wire came in contact with a high tension wire serious consequences also might result, although the probability is that the kite wire would be burned in two immediately. To guard against all these dangers a party of men leave in an automobile as soon as it is known that the kites are loose. On one such occasion recently, when the wind increased suddenly during a flight, the pull on the line reached 400 pounds. The kite wire, which is but little larger than 1-32 of an inch in diameter, broke, allowing a number of kites with several miles of wire to float across the country. The men left at 4 o'clock in the

(*Continued on page 333*)

**Reel house for flying the weather observation kites. Mounted on a turn-table, it faces in any direction**



**The meteorograph. This instrument goes up in the kites and brings back wind, temperature, barometer and humidity records**

## Determining the True Meridian

By J. A. Macdonald

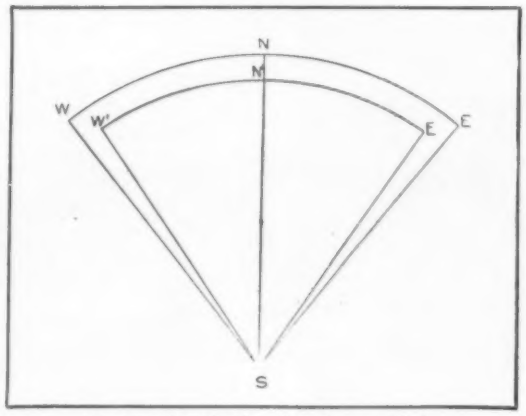
AMONG the simplest ways of determining the true meridian, and, according to my experience, as accurate a means as any, is by equal shadows from the sun. I have tested this method on a meridian carefully laid out by observation on Polaris, and found it to be correct almost to a hair's breadth. Employed by the Romans in laying out their cities and roads, this method is not an approximation, as some surveyors intimate, when the rod or pole used is truly vertical, the observation is correct within at most a minute which is quite close enough for all practical purposes.

On the south side of any level surface erect an upright rod, indicated by S in the cut. Some two or three hours before noon mark the extremity of its shadow with a nail. With S as center, and the length of the shadow SW as radius, strike an arc of a circle. When it begins to approach a time in the afternoon corresponding to the morning time at which the first observation was made, be on hand to watch for the instant at which the end of the shadow again cuts this arc at another point, E. Bisect the arc-segment WE, or more easily the chord WE, at N. Draw SN, and you have the true meridian or north and south line required.

For greater accuracy, a whole day may be given over to the matter, and several observations made at different hours, giving then arcs of different radius. The average of two or three or more such observations should tend to eliminate errors of observation. In our illustration we indicate by W′, N′, E′, the results of a second observation.

Having once laid down this meridian, the observer is in a position to get his own time, independent of all clocks and observatories. It is merely necessary to observe the exact moment at which the shadow coincides with the meridian line laid down. This gives the instant of noon, apparent time. For mean time, it is necessary to consult an almanac to see how many minutes "fast" or "slow" the sun is, and make correction accordingly. For standard time, a correction must be made of one minute for each 15 minutes of longitude east or west of the standard meridian for the time zone in which you are located.

Of course, the method described is based on the fact that the shadow of any object made by the sun will move precisely the same distance in a given time after the instant of noon as it will in the same time before noon. So that when we bisect the distance which the shadow actually covered, we are at the same time bisecting the time, and finding where the shadow, and incidentally the sun, was at noon. The use of the arc is merely a convenient way to identify the interval of time which must be bisected.




Construction for locating the meridian

## The Capacity of a Coal Pile

IN these days of high cost of coal, as well as living, a convenient and quick method of estimating the number of tons of coal in a pile has its value. Many a housekeeper wonders whether the correct amount has been delivered or how much there may be in a pile, but knows no way to check the matter up.

The accompanying chart is offered as a quick method of solving the problem as well as of ascertaining how much hard or soft coal or coke can be piled in a given area. Column B gives the number of tons of 2,000-pound each; column C gives the number of gross tons of 2,240-pound each. The dotted line across the chart shows, as an example, that where the diameter D is 20 feet (Column A) and the height is 10 feet (column D), the pile contains 27.5 tons (column B), or nearly twenty-five tons (column C) depending on whether net or gross tons are considered. Or if it is desired to pile a known number of tons to a known height or diameter, the unknown diameter or height, as the case may be, can be at once found from the chart in similar manner.

The example here used by the New York mechanical engineer who got up this scheme is very unusual, for so large a pile is not common. The angle of repose is seldom so great. For anthracite coal the angle of repose is about twenty-seven degrees; for coke, forty degrees and for bituminous coal, thirty-six degrees. To find the height to which any of those materials can be piled on a plot of a given diameter, multiply the diameter by 0.25 for anthracite, 0.36 for bituminous coal and 0.42 for coke. The chart will then reveal just how much can be piled on a level plot of given surface area. This will also serve as a check against the formation of impossible conclusions from the method outlined in the last sentence of the preceding paragraph.

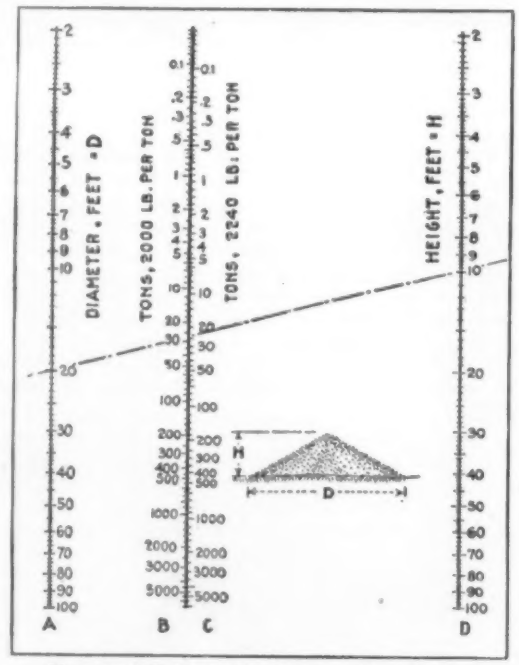



Chart to tell at a glance the number of tons of coal in your pile

## The Present Population of the United States and its Possessions

By Albert A. Hopkins

THE Thirteenth Census of the United States was taken as of April 15, 1910, and included the United States proper and the territories of Alaska, Hawaii and Porto Rico. Other possessions such as the Philippines, Guam, Canal Zone and Samoa were not included. It is necessary to glean the latest figures from estimates of the governors and other officials. The Census authorities have adopted the method of arithmetical progression for computing the estimates of pupulation. It is based on the assumption that the increase each year since the enumeration is equal to the annual increase from 1900 to 1910. We have now figures which are accurate enough for all ordinary purposes bringing them up to July 1, 1916. Thus, we find that on that date we had 102,017,312 inhabitants of Continental United States, and 112,444,620, including all the possessions, to which must be added the population of the newly acquired Danish West Indies with 27,086 making 112,471,706 in all. This figure includes 45,123 persons in military and naval service stationed abroad. The figures for the non-contiguous possessions are as follows:

| | |
|---|---|
| Alaska | 64,834 |
| Guam | 12,866 |
| Hawaii | 215,741 |
| Panama Canal Zone | 31,048 |
| Philippine Islands | 8,834,187 |
| Porto Rico | 1,216,083 |
| Samoa | 7,426 |
| St. Croix | 15,467 |
| St. John | 941 |
| St. Thomas | 10,678 |

Of the population of the United States in 1910, 81,731,957 or 88.9 per cent, were whites; 9,827,763, or 10.7 per cent were negroes; and 412,546, or four-tenths of 1 per cent, were other colored races, including Indians, Chinese, Japanese, Hindus, Koreans, and others. Of the total population, 78,456,380, or 85.3 per cent, were native and 13,515,886, or 14.7 per cent, foreign born, the latter consisting chiefly of whites.

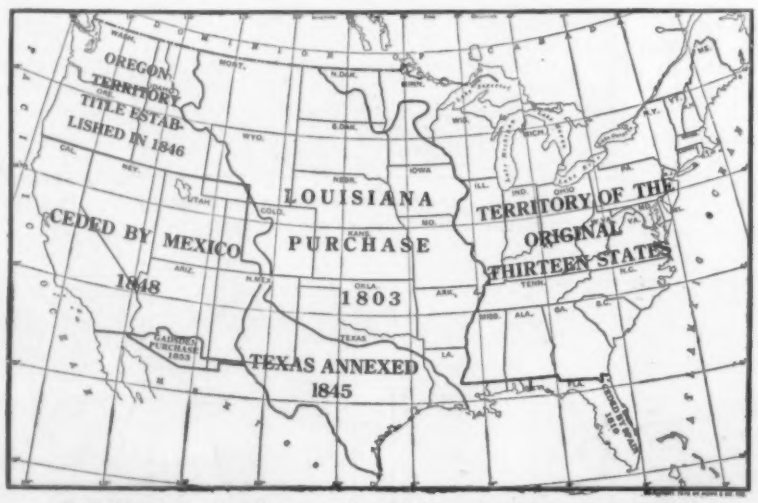
The native white population numbered 68,386,412, and constituted 83.7 per cent of the white population and 74.4 per cent of the total population of the country. The 13,345,545 foreign-born whites constituted 16.3 per cent of the white population and 14.5 per cent of the total population.

Since 1890, the first census to include an enumeration of Indians in Indian territory and on Indian reservations, the Indian population had increased slightly, being 248,253 in 1890 and 265,683 in 1910. During the same period the Chinese population decreased from 107,488 in 1890 to 71,531 in 1910, while the Japanese population increased from 2,039 in 1890 to 72,157 in 1910. There were also enumerated in 1910 other non-white races, mainly Hindus and Koreans, to the number of 3,175.

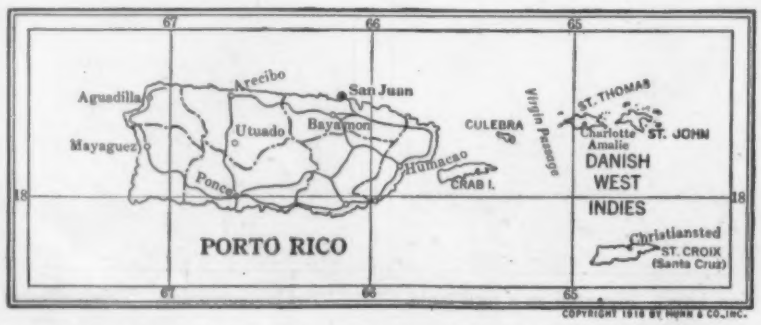
At the close of the first census, in 1790, the United States comprised substantially the territory between the Atlantic Ocean and the Mississippi River except Florida, representing a gross area (land and water surface) of 892,135 square miles. The United States with its outlying possessions, now comprises a gross area of 3,743,450 square miles, or more than four times the area in 1790.

One of our maps shows the juxtaposition of the Danish Islands to Porto Rico, thus controlling an important gateway to the Caribbean Sea. The other shows how the territory of Continental United States has become enlarged from time to time by conquest, or purchase, usually the latter, until all the diverse elements have been welded into a united people. The government of our island possessions is particularly good as can be verified by a visit to Porto Rico where the progress of education has had an enormous leavening influence on the people. Citizenship has recently been granted to the people of Porto Rico, who certainly deserve it for they are patriotic to the core. There is only one regiment allowed by law in the island, but there are seven applications for every vacancy.

On another page will be found a comparison showing the United States garbed as "Uncle Sam," explaining his mission of civilization to his dependent peoples. The figures are all drawn to scale. The United States is fortunate at the present juncture to have a peaceful group of insular possessions which hold such wonderful prospects for the future.


OREGON TERRITORY TITLE ESTABLISHED IN 1846
LOUISIANA PURCHASE 1803
CEDED BY MEXICO 1848
TERRITORY OF THE ORIGINAL THIRTEEN STATES
TEXAS ANNEXED 1845

United States, original area, and acquisitions of territory, 1790 to 1910




Our new possessions in the West Indies and their relation to Porto Rico

## A Vegetation Map of the United States

MR. FORREST SHREVE has prepared for publication by the Carnegie Institution of Washington a map of the principal vegetational areas of the United States, constructed on a novel plan. As the chief use of the map is to be in connection with studies on the correlation of vegetation with climate, it has been based solely upon the collective physiological behavior and anatomical character of the plants concerned, no weight being given to floristic relationships, nor to any of the climatic, physiographic and geological factors known to influence the distribution of vegetation.

### Bringing the Aeroplane Within Reach of the Sportsman

BEYOND any doubt the main reason why every sportsman is not flying about to-day is because the aeroplane designers have thus far failed to meet popular requirements. There is no more reason why the sportsman should purchase a heavy, high-powered military biplane for his requirements, than a five-ton motor truck when all that he needs is a light roadster.

Now comes a one-man sporting biplane designed by S. S. Pierce, which bears the same relation to the usual two-seater, low-powered aeroplanes that the light-weight and inexpensive roadster bears to the seven-passenger touring car. This machine has a 26-foot wing spread and is of the tractor design. The motor is a three-cylinder radial type, developing about 35 horse-power. It is intended to sell this type of aeroplane for about $3,000.

Copyrighted, International Film Service

**This single-seater aeroplane, equipped with a 35-horse-power engine, has been designed for the sportsman**

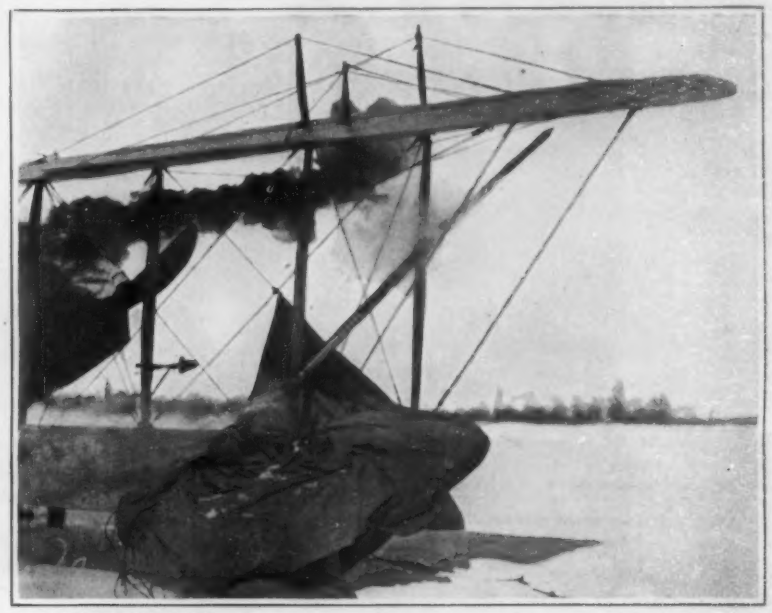
### Incendiary Rockets which Spell Doom for Captive Balloons

AMONG a thousand-and-one other things the present war in Europe has taught us the importance of destroying enemy observation or captive balloons preparatory to delivering an attack; for the element of surprise is impossible so long as the enemy is in possession of his means of observation or "eyes."

It is only lately that the United States Army has undertaken experiments with a view to perfecting methods of attack on captive balloons, and one of these methods was recently given a test at the Mineola flying grounds The device employed consists of a brass tube some four feet long, open at one end and fitted with a plug member at the other. Into this tube is placed a special incendiary rocket whose fuse is incorporated into an electric circuit so that it may be fired electrically upon the closing of the circuit by a push-button in the cockpit of the aeroplane. The tube, being rigidly held in place, cannot be aimed at the target; accordingly, it becomes necessary for the aviator to maneuver his machine until it is in line with the victim, when the electric circuit is closed and the rocket discharged. This procedure is similar to that employed in aiming the fixed machine guns on single-seater fighting planes used by the Germans and the French on the Western front.

Copyright, International Film Service

**The incendiary rocket gun for destroying captive balloons: Loading the tube before the flight**



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**The incendiary rocket at the moment of discharge. Note the trail of smoke in its wake**

### An Aviation Gun-Camera of American Manufacture

AERIAL photography, which has played an important part in aerial reconnaissance work on the European war fronts, is rapidly attaining a high degree of efficiency in the United States flying corps. American manufacturers of cameras, however, have not as yet given much attention to this branch of photography, and their products have not had the streamline design that is so essential.

The most recent camera employed at the Signal Corps aviation school at North Island, San Diego, Cal., is a rather cumbersome affair when it is raised over the fuselage of an aeroplane traveling at more than 85 miles an hour with the resultant heavy wind pressure. Yet this camera has proved its worth, judging from the excellent photographs that have been secured of the terrain adjacent to San Diego from altitudes varying from 3,000 feet to one mile This camera, which is shown in the accompanying illustration, is fitted with Springfield rifle sights and is operated with a trigger arrangement. It is fitted with a telescopic lens of 24-inch focus. At an altitude of nearly two miles the camera photographs one square mile of terrain.

A magazine holding twelve photographic plates is normally used with the camera, although in place of the plates a roll film holder may be used In either case a fresh plate or film surface is brought into position by a device operated with the trigger.

A telephoto, which is a small aerial photographic apparatus used extensively by the German flying corps, has also been tried out at North Island school with considerable success.

The aeronautical authorities advocate the cutting of a small hole in the bottom of the fuselage of all reconnaissance aeroplanes employed by aerial photographers. The observer can point the camera directly toward the point where it is desired to obtain an accurate photograph; and at the same time this will eliminate the danger of the camera slipping from the hands of the photographer—a common accident when the instrument is held over the side of the fuselage. Perhaps transparent bottoms would prove most effective in this connection.

**This aeroplane camera is fitted with Springfield rifle sights and is aimed much in the same manner as a gun**

### The New Stainless Steel

A STEEL that does not stain nor tarnish is one of the latest new materials and will be welcomed by the housewife as a real boon. It is called "stainless steel" and from it table cutlery is being made which not only takes a beautiful polish, but which preserves this appearance under all circumstances It also keeps a sharp edge for a long time Foods or ordinary acids do not tarnish it and it is fast becoming very popular. To be able to use ordinary knives or forks and by simply washing them, even without drying them, to have them maintain their original brightness is a much desired achievement and one eagerly welcomed by the diligent and particular housewife.

The new steel was discovered in England but is now being made in the United States and sold as table cutlery. It is what is commonly called an alloy steel, that is, it differs from ordinary steel in that it contains a special element or metal. In this case it is chromium, which is mainly responsible for bestowing the stainless and rustless properties. By incorporating from twelve to thirteen per cent of this metal in mild carbon steel, the new properties are obtained An English metallurgist, in gathering together some rods of steel which had lain a long time in his laboratory, noticed that while most of them were badly rusted or stained, a few were as bright as when originally made. This led to the present discovery and manufacture of the steel.

The new steel is more expensive than the old which usually appears in the every-day table knife. Its advantages and lasting properties as well as its appearance and the convenience arising from its use more than offset the extra cost. The fact that it does not tarnish, stain or corrode augments its value decidedly. It is supplanting not only the old steel cutlery, but also the plated Its possibilities, however, are by no means limited to cutlery. One can readily imagine to what countless uses a stainless and rustless metal can be put.

# Inventions New and Interesting

## A Department Devoted to Pioneer Work in the Arts

### Right-Weight Packages

IN selling such commodities as sugar, rice and coffee, a grocer will often have the packages made up and ready for the customer, so that the clerk does not need to delay in the busy hours to weigh out a dollar's worth of sugar. Quick work and absolute accuracy in making up these packages results from use of the electrically-operated scale shown herewith.

The funnel-shaped container holds a large quantity of the commodity being put up—about a hundred pounds

**A scale that stops the stream of sugar when the proper weight is reached**

of sugar, and other things in proportion It is filled by swinging the scale to one side and lowering the hopper to the floor When filled, it is a simple matter to slide it back up the steel frame to its working position, and swing the scale back under the mouth. Then a paper sack is set under the funnel and at the touch of a button a stream of sugar descends—or flour, or whatever else is being packed.

The size of the package can be adjusted to the daily price of the commodity. Suppose the dollar's worth of sugar is fourteen pounds, eleven ounces The clerk does not need to watch the dial and turn off the stream when each package reaches that weight. All that is necessary is for him to set a little metal point at the appropriate spot along the margin of the dial; and when the hand, revolving under its increasing load, reaches this, an electric contact is made and the circuit operates the little gate that checks the flow of sugar into the bag.

In this way a clerk can accomplish several times as much work as he could by the weighing of individual packages on ordinary scales. And all danger of making the package over or under weight is avoided. Incidentally, the scale can also be used to advantage in weighing out articles while the customer waits. The electrical energy which controls the device is very slight, a few dry cells being quite sufficient.

### Scrubbing by Electricity and in a Sanitary Way

AN electric scrubber that cleans the floor and removes the water in one operation is the latest recruit to the multitudinous labor-saving devices which may be connected to any lamp socket. The present machine places clean water only on the floor and does not scrub with dirty water; hence, aside from its labor-saving features, it has the added property of extreme sanitary scrubbing to commend it

Weighing about one hundred pounds and measuring 28 inches long and 20 inches wide, the electric scrubber is readily pushed about by the operator. Current for the one-quarter horse-power electric motor which drives the mechanism is furnished from the nearest lamp socket, through a long, flexible cord that is paid out by a cable reel mounted on the scrubber; and in this way the operator may work at a considerable distance away from the nearest socket. The cord is wound up automatically on the reel and at no time touches the floor.

The electric scrubber wets, sweeps, scrubs and removes the dirty water from the floor, all in one operation The attendant pushes the machine forward; the machine does the rest. The tank of the machine holds eight gallons of water in which may be placed soap solution, or disinfectant if required. The water is distributed by pipes to the floor and is under the control of the operator, from the handle. The floor is scrubbed by a cylindrical brush 22 inches in circumference and 16 inches long, revolving at 600 r.p.m., which sweeps the dirty water into a receiving pan after scrubbing. Thus the machine is always scrubbing with clean water, in marked contrast to the manual method in which the same water is in continuous use

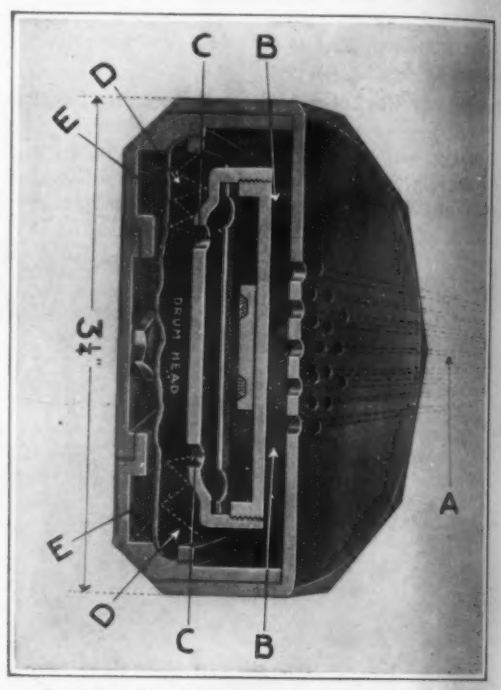
It is claimed that the electric scrubber does the work of five to ten persons, and that if the attendant pushes the machine at the rate of one mile per hour, it will cover approximately 5,000 square feet of floor per hour This is at least five times as much area as a hand-scrubber will cover in the same period, and may be as much as ten times if the floor is exceptionally dirty.

### Made-to-Order Electrical "Ears" for the Deaf

IMPROVEMENTS in the mechanical application, rather than in the electrical principles of the microphone, have produced a new electrical "ear" or "earfone" for the deaf which, it is claimed, not only sifts out all grating, buzzing and rumbling sounds which are highly confusing to the user, but actually amplifies the sound received to such a degree and in such varying tones that almost any case of deafness can now be relieved. But the main feature of this new form of earfone is that it is made to order, as it were, to meet individual requirements

The inventors of the new instrument have applied entirely new principles to their earfone Heretofore, improvement has been sought in the microphone itself, but in this instance they have sought improvement in the handling of the sound waves before they reach the diaphragm. They claim that the loss of sound by the rebounding of the waves out of the instrument is the first great loss in the usual microphone, and this they have sought to remedy by carrying the waves around the interior of the instrument and taking them to the diaphragm located deep within the instrument and not at the front, as in conventional practice. In this manner, they claim, the loss of waves is eliminated; furthermore, and with the aid of perforated steel walls through which the waves must pass, the minor gratings and buzzings now so characteristic of the microphone are sifted out.

The method of amplifying the sound is also mechanical and fully as ingenious. It is no less than the application of the principle of a curved sounding-board or drumhead This is located inside the transmitter and directly in front of the diaphragm, so that the sound waves, traveling around the outer shell of the transmitter,




**Sectional view through a microphone designed for the deaf**

strike the sounding-board and are reflected in amplified strength against the diaphragm.

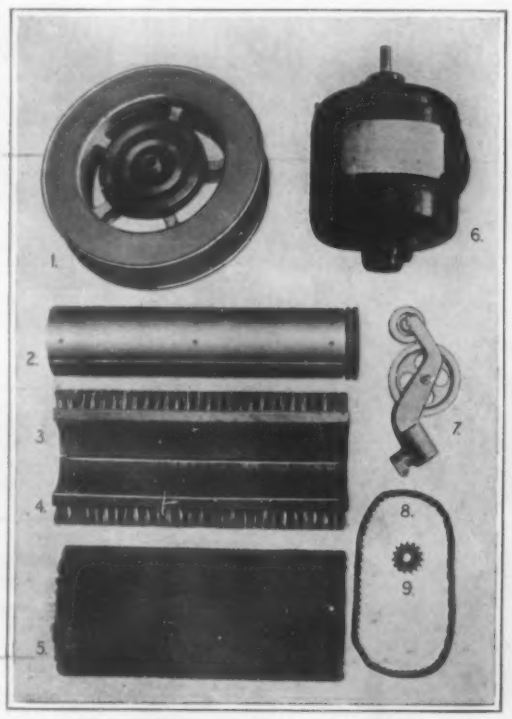
The sounding-board has also given the new instrument a tremendous advantage over anything yet placed on the market, according to the inventors. By variations in the material of which it is made, and the form of its curvature, the individual ear can actually be fitted so perfectly that a deaf person can hear all words and sounds in their natural tones.

A part of the equipment of the new instrument's makers is a simple yet effective testing chamber, by means of which the aurist can plot the patient's defects and, by altering the curvature of the sound-board fit the ear exactly. The curve of the sounding-board decides, to explain it roughly, the force of the sound-wave, while the material of which it is made determines the quality of the tone. If the sounding-board is of brass the reflected sound takes on a sharp, ringing quality, while if it is of lead, the reflection need not be less forceful—if the curvature is considered—while the tone itself is softer and rounder.

As previously stated the new instrument does not rely on electrical regulators or rheostats to increase or decrease the volume of sound. This instrument is fitted with the microphone working normally, and electrical control is used after the fitting at the patient's will, to increase or decrease the volume; for, as is well known, deaf persons have their "good" and "bad" days, and the ability to control the sound at will is accordingly of vast importance.

Referring to the accompanying sectional view of the

(Concluded on page 334)




**A few of the components of the electric scrubber**

**This electric scrubber does the work of five or more human scrubbers**

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Standard of the World

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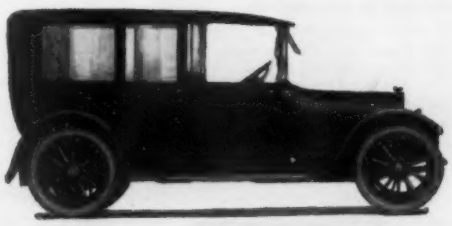
It would be difficult for you to suggest to yourself any qualities which could contribute more thoroughly to your comfort and your enjoyment.



The complete line of Cadillac cars is as follows–: Seven-Passenger Touring Car;–Four-Passenger Phaeton;–Two-Passenger Roadster;–Four-Passenger Club Roadster;–Four-Passenger Convertible Victoria;–Seven-Passenger Convertible Touring Car;–Four-Passenger Coupe;–Five-Passenger Brougham;–Seven-Passenger Limousine;–Seven-Passenger Imperial;–Seven-Passenger Landaulet.

Cadillac Motor Car Co. Detroit, Mich.

## RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

### Pertaining to Apparel

LINING FOR HATS.—A. KURTZ, 10 Sackman St., Brooklyn, N. Y. In this case the invention provides a lining having incorporated between the side piece and crown piece thereof, an exposed cord; provides means for holding said cord in service relation, and provides means for concealing the raw edges of said cord.

### Electrical Devices

COMBINATION FLOWER POT AND REFLECTOR.—A. E. POHLMAN, General Delivery, West Allis, Wis. The invention provides a lamp with a reflector and globe so arranged as to result in an effective lighting of a room, and so combine a flower pot with the lamps as to improve the appearance of the latter; and provides ample space for earth or water, or both, between the reflector and a shell member, or members.

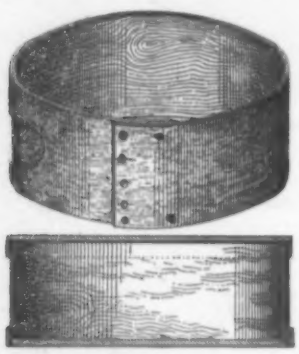
ELECTRIC DISPLAY DEVICE.—C. TREGONING, 260 W. 43d St., New York, N. Y. This invention has reference to electric displaying devices and particularly to a construction for displaying lamps, and has for an object the provision of a simplified, strong and efficient structure for moving lamps in a predetermined order for display purposes.

### Of Interest to Farmers

FERTILIZER DISTRIBUTER AND PLANTER.—L. MERLBERGER, Box 132, Easton, Pa. The present invention has more particular reference to the hopper attachments for regulating the discharge of the fertilizer or seed therefrom, and to the table onto which the fertilizer or seed is delivered from the hopper to revoluble distributing means arranged in connection with said table.

### Of General Interest

ROUND BOX.—C. R. MELDRIM, Cincinnatus, N. Y., and J. J. MELDRIM, Truxton, N. Y. Address the former. Cheese boxes as heretofore made have been usually cut or veneered around the log about one sixth of an inch thick and it is found by actual experience that there is waste of approximately one third from selected veneer logs and a waste of approximately one half of veneers made from ordinary good veneer

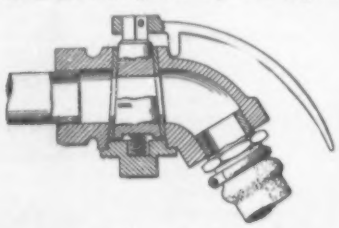


ROUND BOX

logs, owing to the presence of knots and other imperfections which must be trimmed out of the veneer as waste. The invention overcomes the wastage of material and substitutes other and cheaper kinds of wood, elm being now chiefly used, for forming cheese boxes and the like

### Hardware and Tools

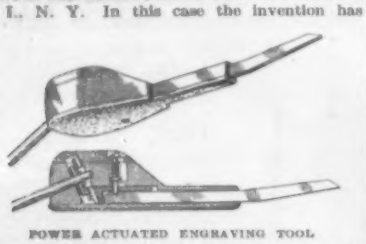
ANGLE COCK VALVE.—R. A. CALDWELL, care of Burlington Hotel, 235-337 E. Second St., Los Angeles, Cal. This invention relates generally to valves and more particularly to an angle cock



ANGLE COCK VALVE

valve, the object being to provide a simple, inexpensive construction, whereby the train line may be cut off and the pressure bled from the air hose in a simple and effective manner preparatory to uncoupling and moving the hose.

POWER ACTUATED ENGRAVING TOOL.—W. E. STEPHENSON, Roosevelt Ave., Roosevelt, L. I., N. Y. In this case the invention has



POWER ACTUATED ENGRAVING TOOL

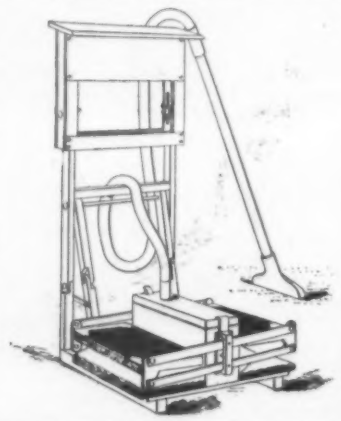
reference to a power-driven engraving tool; and the object thereof is the provision of a simple, convenient and efficient tool which can be easily manipulated and properly guided while driven. The housing of the tool is shaped so as to be easily accommodated in the hand.

### Heating and Lighting

DRYING APPARATUS.—E. J. M. MARTINI, Rue Charles Cazin, Paris, France. This invention provides an apparatus allowing to obtain the rapid drying of solid materials and operating this drying in a closed aseptic medium. The invention is characterized by a device allowing a continuous circulation of the air and vapors, capable of being self-maintained without the help of any pump or any other apparatus of this kind and in a closed aseptic medium.

### Household Utilities

PUMPING MECHANISM FOR VACUUM CLEANERS.—A. J. FAUCHER, 402 South Vine St., Wichita, Kan. The invention relates to a vacuum cleaner adapted to be operated in a stationary position and connected by a flexible



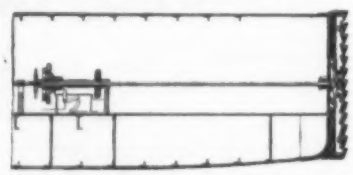
PUMPING MECHANISM FOR VACUUM CLEANERS

hose with a suction nozzle, which is adapted to be moved over the surface or surfaces to be cleaned. It provides manually operated pneumatics so arranged as to enable the same to be operated with a minimum effect on the part of the operator.

CONDIMENT HOLDER.—P. L. FERGUSON, 2451 Quincy Ave., Ogden, Utah. This improvement provides a holder having a plurality of independent compartments for containing different condiments each having a discharge opening near the top of the holder, and wherein a cover is mounted to move on the holder at the top, and normally covering the discharge openings and having a series of perforations so arranged that by turning the holder the series may be brought into register with the port or discharge opening of either compartment.

### Machines and Mechanical Devices

NET CUTTING AND SIGNAL ATTACHMENT FOR SUBMARINES.—G. TAUBERT, Columbus Ave., Pittsfield, Mass. This invention has particular reference to improvements in submarine craft whereby they may be able to extricate themselves from sub-surface net work of



NET CUTTING AND SIGNAL ATTACHMENT FOR SUBMARINES

wire or the like. It provides an attachment for the bow of a submarine boat or the like whereby the officer of the boat will be immediately apprised of the presence of a net when the same is encountered. It provides an attachment comprising cutting devices for the extrication of the boat from an entanglement.

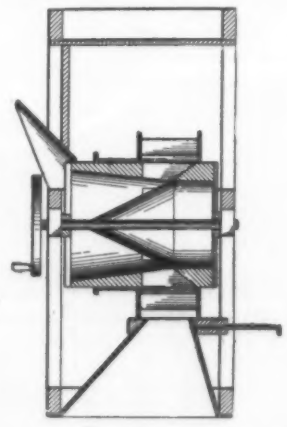
BOTTLE WASHING MACHINE.—I. COLE, address Rapid Bottle Washer Co., Delphos, Ohio. The inventor provides a machine with devices for receiving an conveying bottles in succession into and through a cleansing fluid and thence between a plurality or series of brushes which act upon all parts of the bottle, giving them a thorough scrubbing as they pass along toward the point of discharge.

DITCH AND SEWER DIGGER.—C. BAUER, 820 Hughes St., Zanesville, Ohio. The invention provides a sewer digger having an improved adjustable elevator and operating mechanism therefor. It provides a digger having an adjustable elevator and a conveyor and means for transferring earth from the elevator to the conveyor irrespective of the adjusted position in which the elevator may be.

MACHINE AND PROCESS FOR PULLING CANDY.—J. M. HOWARTH, 622 Grand Ave., Wausau, Wis. The improvement has reference to a device for stretching or pulling certain kinds of candy. Among the objects is to provide a machine which is capable of pulling certain kinds of candy which require a certain amount of working before reaching a state from which they will readily harden.

FLUID PRESSURE GOVERNOR.—H. A. HAYWARD, care of Connelly Iron Sponge and Governor Co., 127 Duane St., New York, N. Y. This invention relates to fluid pressure governors and has particular reference to devices of this character adapted to automatically govern the flow of fluid and deliver the same at a substantially uniform pressure materially reduced from a higher pressure of either regular or irregular tendency.

ORE SAMPLER.—F. B. POTT, 119 W. 4th St., Leadville, Colo. In this invention use is made of a revoluble drum open at one end, a cone arranged centrally within the said drum and rotating with the same, the apex end of the cone



ORE SAMPLER

leading to the open end of the said drum, buckets peripherally on the said drum and opening onto said cone, and means for delivering the material to be sampled into the buckets at the time the latter reach an uppermost position.

### Medical Devices

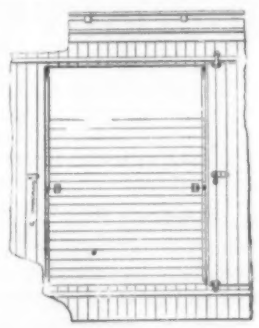
SURGICAL DEVICE.—J. S. FALCK, Box 1233, Washington, D. C. The invention provides a device comprising a semi-rigid, elastic, split sleeve, means of closing the split hidden within the material of the sleeve and a lip extending on the inner side of the said closing means and across the split when the sleeve is closed.

### Prime Movers and Their Accessories

ENGINE ATTACHMENT.—T. L. KIRBY, Hartsville, Tenn. The improvement provides an attachment for use with internal combustion engines, adapted to be arranged between the carbureter and the intake manifold, and having means for breaking up the particles of unvaporized fuel to form a more volatile gas, more explosive in its nature, and to provide a more thorough and intimate mixture.

### Railways and Their Accessories

GRAIN CAR DOOR.—N. TERRY, Box 81, Hardisty, Alberta, Canada. This invention provides a grain door at the inside of the main door so constructed and arranged as to provide for the ready release of the lower section of the door notwithstanding the pressure of the loose material



GRAIN CAR DOOR

against the door. The door may be moved to a position beneath the roof of the car when not in use, the door and its appurtenances being so arranged that no elements will project at the doorway to offer obstruction or interference when the car is unloaded.

### Pertaining to Recreation

TOY REPEATING GUN.—C. B. OSBORN, Box 867, or 901 Dallas St., San Antonio, Tex. This is a gun which may be cocked and fixed by the manipulation of a single member and which embodies a magazine to receive a number of projectiles which automatically feed by gravitative action into proper position to be projected by the striker or discharging member. The action comprises an operating member and a catch, the

TOY REPEATING GUN

former embodying a trigger, a striker and a main spring, the trigger serving the two-fold purpose of cocking and discharging the gun. Forward movement of the trigger cocks the gun, whereas rearward movement of the trigger places the main spring under tension and effects release of the striker or discharging member which is thrown forward by the action of the main spring to project the missile.

Note.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of patentee, title of the inventor, and date of this paper.

## Strategic Moves of the War—March 22d, 1917

(*Concluded from page 324*)

ing the spring and early summer of 1915.

In Macedonia the French claim to have won a brilliant victory over the German-Bulgar forces north of Monastir, where after savage fighting for nine days, often in heavy snow storms, some towns and important heights have fallen into French hands with a number of prisoners and machine guns. In the section around Lake Dorian, the British have also had some minor successes.

On the Italian front snow has prevented active operations, but there has been much aerial fighting with advantages claimed by both sides. Naturally also artillery bombardments are kept up constantly.

In Mesopotamia, Persia, and Armenia, the Russian forces are making constant advances; they have crossed the border from Persia, on the road to Mosul and, by way of Kermanshah and Khanikin, must soon join hands with the British coming up the Tigris. It now looks as if the Russians would be in Mosul before the Turks, retreating from Bagdad, reach that place; in such a case there will be nothing for that army to do but to surrender. Already the retreat has become a rout and little or no resistance is being offered to the British troops coming up the Tigris. Why the British forces in Palestine have not advanced from Hebron upon Jerusalem and have not taken that city must rest wholly upon lack of supplies, or reinforcements, and possibly desire to await conclusions with any Turkish troops to the south along the Hedjaz railway. It cannot be long now before Jerusalem falls and Turkish rule there terminates. The influence in the Mahommedan world with Bagdad and Jerusalem in Christian hands cannot be measured; it can be said only that it must mark the downfall of Turkish power over the lands so long subject to the rule of Constantinople; and its effect in Berlin, coupled with the Somme retirement and the happenings in Russia, must be disastrous in the extreme.

## Twenty Years' Development of the Holland Submarine

(*Concluded from page 323*)

face at 20 knots. In the next compartment are the electric motors, two on each shaft; and in this room also is located various auxiliary machinery. The last compartment is given up to water ballast.

The torpedo armament is very powerful, consisting of four fixed tubes in the bow and four tubes arranged in pairs on two revolvable mounts, which are carried above the main hull and within the false superstructure. These tubes are capable of being fired through a wide arc on either bow. The concentration of torpedo fire is such that four torpedoes can be fired dead ahead on the longitudinal axis of the boat and four can be fired on either broadside.

In closing we wish to draw attention to the fact that the displacements given throughout the article and in our diagram are the submerged displacements. It is customary, at least in the United States, to refer to the size of submarines in terms of their surface displacement. The "Schley" therefore of 1915 is a 1,200-ton boat and the preceding type of 1913 represents, so far as size is concerned, the 800-ton type which the majority of our naval officers consider to be the best for the conditions which confront the United States Navy.

## The Current Supplement

AN article containing much matter of general interest, in the current issue of the *Scientific American Supplement* for March 31, No. 2152, is that on *World Wide Changes of Temperature*, which discusses the possibilities of making seasonal forecasts for a study of the weather world. *The Cohune Palm* describes a Central American tree that produces nuts from which a valuable oil is obtained. It is fully illustrated. *The Laundries of the Ancients*, as the title suggests, describe methods employed in the early days of civilization for cleansing clothing; and is

(*Concluded on page 334*)

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### Flying Kites to Study Weather

(*Concluded from page 327*)

afternoon to recover the kites. The loose end of the wire had caught on a fence near Florence, Neb., a suburb of Omaha, twenty miles away, while the kites remained in the air. The kites were then pulling about 250 pounds on the wire and it was 3 A. M. the next day when they had been landed and taken back to the station.

Static electricity gathering in the kite wire presents one hazard in the work. A voltmeter in the reel house registers as high as 50,000 volts and on several occasions its capacity has been exceeded. The reel itself, mounted on insulators, is connected with the ground by large wires to carry off the electricity that is drawn down the kite wire. By opening a switch that connects these large wires with the ground, the electricity is sent through the voltmeter instead. Naturally while the current is being measured, the reel itself becomes highly charged and great care has to be taken not to touch it inadvertently. When the reel is thus disconnected in the evening, it often glows with the pale blue discharge.

Each evening the results of the day's observations are telegraphed to Washington and Chicago for assistance in making up the weather forecasts for the next day. At longer intervals the tabulated results are forwarded to Dr. William R. Blair of Washington, who is in charge of all the aerological work, for more detailed study. During the year ending December 1st, 1916, 528 flights had been made in Nebraska. Flights were made on every day except twenty and twice a month the thirty-six hour periods of nine flights each were observed. The average altitude reached by the kites was one and a half miles and the highest about three and a half miles.

The entire study of the upper atmosphere as carried out by the weather bureau under Doctor Blair's direction is comparatively new. The Hargrave box kite, used for the observations, is not a quarter of a century old, despite the age of kite flying itself, and too sensational results can not be expected in so short a time. Without going into the subject too far it may be said that kite flying has brought out facts which, when correlated with other material, will, it is believed, produce interesting results. In general all winds are from a westerly direction if one goes high enough. It is not unusual for the wind to be from the southeast on the ground. A half mile up it may be from the south, while a mile up it quite probably is from the southwest. Observations made with kites have shown that at a mile and a half above sea-level the moisture content of the air is one-third what it is at sea-level and at three miles one-tenth.

Some interesting facts regarding upper air temperatures have been determined by means of kites. In discussing this phase of the subject Mr. Sherry said: "In the winter during the night the temperature grows warmer for the first quarter to half mile of altitude. In the summer it grows colder usually up to an altitude of about eight miles. During the coldest part of a summer morning it will sometimes be somewhat warmer a few hundred feet high than it is on the ground. While in the winter it will be warmer a few hundred feet above the ground at night, during the day it will be a little colder. At all other times the temperature will, as a general thing, decrease with altitude up to what is sometimes called the 'isothermal layer.' The altitude at the base of the isothermal layer varies from day to day and also with the seasons. It is usually found at about eight miles above the level of the sea, but it may vary from six to ten miles above sea-level. In the isothermal layer the lowest temperature is usually found. With the aid of sounding balloons self-recording instruments have been carried to altitudes as high as twenty miles above sea-level. These instruments indicate that above the base of the isothermal layer there is very little change of temperature with altitude, although sometimes it grows a little warmer above the base of the layer,

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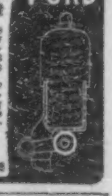


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# A Business Revolution

**Just what Russia's cataclysm can mean to America's commercial interests, what part Russia's business men had in the uprising, what their attitude will be toward foreign trade, is told in this week's Leslie's in**

***"America and the New Russia"***

***By LUCIAN SWIFT KIRTLAND***

**Mr. Kirtland has recently returned from Russia where he has been acting as Leslie's staff correspondent. He is a student and writer on economics and business.**

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*Illustrated Weekly Newspaper*
*Established in 1855*

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sometimes shows practically no change and sometimes grows a little colder. The temperature falls about three degrees for every 1,000 feet of ascent, as a general thing, up to the isothermal layer. Temperatures as low as ninety-four degrees below zero have been recorded at approximately eight miles above the ground."

In the opinion of Mr. Sherry valuable results will accrue from the work being done at the present station and at prospective stations, which may be located at other points in the Middle West. Other government departments, besides the Weather Bureau, are free to avail themselves of the results achieved. Practically all of the foreign countries engaged in the present war have maintained one or more stations for investigating conditions in the upper atmosphere and it is quite probable that not a little of the efficiency of the Zeppelins and the giant guns may be traced to an accurate knowledge of the winds and upper air conditions. It is possible to see where the results of the work might be of great service to aviators. A foreknowledge of unstable conditions in the upper air might perhaps save many accidents. When there are more airships than automobiles might it be too much to expect that we will have the skies as well as the roads charted and that the aviator will stop to consult the bulletins on upper air conditions just as the automobilist consults the latest road bulletin today?

### Made-to-Order Electrical "Ears" for the Deaf

*(Concluded from page 330)*

new earfone, it will be noted that the sound waves enter at *A*, through perforations in the casing. These do not strike the diaphragm, but are deflected on all sides and pass to the outer rim, as if one were using a stream of water driven against the button in a spray nozzle. The waves are carried through *B* and *D* to the drumhead or sounding-board from which they are reflected through another perforated wall, at *C*, to yet another resonator, which, like the canals of the ear, softens the harsh sounds till they strike the diaphragm with the quality of the sound reaching the normal ear, according to the inventors' claims.

One of the most important features of the transmitter is that the sound waves are thrown against the periphery of the diaphragm instead of on the center, as in telephones and ordinary microphones. This takes advantage of full movement of the diaphragm, and, as a result, eliminates all loss of sound to the microphone.

In appearance the new instrument is small and neat. The ear-piece is only an inch and a half in diameter, and the transmitter is only three inches in diameter. The latter can, therefore, be concealed in the clothing much more simply and the ear-piece handled or worn inconspicuously.

### The Current Supplement

*(Concluded from page 332)*

illustrated by sketches. An article of much scientific interest is on the *Importance of the Relation of Solid Surfaces and Liquid Films in some Types of Engineering Construction*, and deals particularly with asphalts and bitumens. *New Work for Women Created by the War* refers to the entry of women into the mechanical trades, and is illustrated by a number of photographs taken in the Canadian munitions shops. Another valuable article dealing with the forecasting of changes of temperature is on *The Value of High-Level Meteorological Data*, and it is accompanied by numerous charts and tables. *Weighing Apparatus in Industrial Plants* deals with a subject of importance to every manufacturer and merchant, as it discloses facts that are too seldom known, or recognized; and it contains valuable suggestions for the selection and maintenance of proper weighing machines. Other articles of value are *The Influence of Some Elements on the Mechanical Properties of Steel*, *The Training of the Analyst*, and *Boiler Efficiency*. There are a number of shorter articles of general interest.


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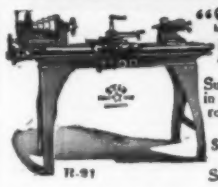

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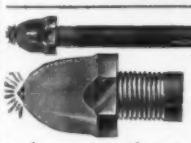

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## PATROL SQUADRON

**Room 640, Woolworth Building**
**NEW YORK CITY**

To the eye the bearing surface is smooth as glass—

But the microscope reveals its roughness.

# WORN BEARINGS

## *What do they mean?*

THE repair man says: "That knock? Worn bearings." Tightening will temporarily remedy the trouble. Refitting or renewing is the only permanent remedy. But it is more important to know what will help prevent this expensive operation.

To the eye, the surface of a bearing is smooth. But under the microscope it has a very different appearance. You see a succession of little hills and valleys.

Now, imagine the engine in motion.

What happens?

Surfaces are in motion. Unless protected by a correct film of lubricating oil, the microscopic hills of metal meet and rub. The engine-power overcomes this resistance, but tiny particles of metal grind off.

By degrees the snug fit becomes a loose fit. Noise follows. To correct this condition now, the bearings must be refitted or renewed.

The only protection against undue wear of bearings is the thin film of oil.

This thin film of oil must be highly elastic. It must fill-in the valleys. It must cushion the peaks and withstand pressure. It must stand up under the heat of service. These requirements call for oil of the very highest quality and of the correct body and character.

Gargoyle Mobiloils meet these requirements with scientific exactness. Used as specified in the Chart of Recommendations they effectively cushion the bearing surfaces, and meet the most severe demands of service and heat.

GARGOYLE

## Mobiloils

*A grade for each type of motor*

In buying Gargoyle Mobiloils from your dealer, it is safest to purchase in original packages. Look for the red Gargoyle on the container. If the dealer has not the grade specified for your car, kindly write our nearest branch, giving dealer's name and address.

VACUUM OIL COMPANY
Rochester, N. Y., U. S. A.

**Specialists in the manufacture of high-grade lubricants for every class of machinery. Obtainable everywhere in the world.**

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### Correct Automobile Lubrication

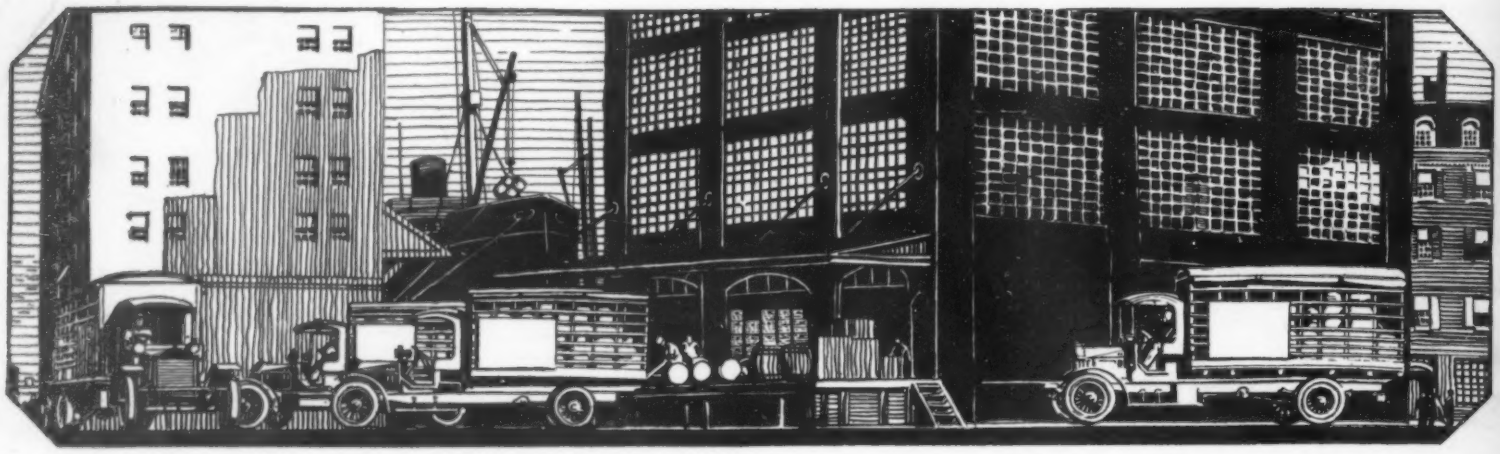
***Explanation:***—The four grades of Gargoyle Mobiloils, for engine lubrication, purified to remove free carbon, are:

**Gargoyle Mobiloil "A"**
**Gargoyle Mobiloil "B"**
**Gargoyle Mobiloil "E"**
**Gargoyle Mobiloil "Arctic"**

In the Chart below, the letter opposite the car indicates the grade of Gargoyle Mobiloils that should be used. For example, "A" means Gargoyle Mobiloil "A," "Arc" means Gargoyle Mobiloil "Arctic," etc. The recommendations cover all models of both pleasure and commercial vehicles unless otherwise noted.

| Model of | 1917 | | 1916 | | 1915 | | 1914 | | 1913 | |
|---|---|---|---|---|---|---|---|---|---|---|
| CARS | Winter | Summer | Winter | Summer | Winter | Summer | Winter | Summer | Winter | Summer |
| Abbott-Detroit | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | A | Arc |
| " (6 cyl) | | | | A | A | A | | | | |
| Allen | A | Arc | A | Arc | A | Arc | A | A | A | A |
| " (Mod. 32-34-35) | | | | | A | Arc | | | | |
| Apperson | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc |
| " (6 cyl) | A | A | A | A | | | | | | |
| Auburn (4 cyl) | | | A | A | Arc | A | Arc | A | A | A |
| " (6 cyl) | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | | |
| Autocar (2 cyl) | A | Arc | A | Arc | A | Arc | A | Arc | A | Arc |
| Avery | | | A | A | A | A | A | A | A | A |
| " (Mod. 3 & C 1 ton) | | | Arc | Arc | Arc | Arc | Arc | Arc | | |
| Belgrin | A | Arc | A | Arc | A | Arc | A | Arc | | |
| " (8 cyl) | | | A | A | | | | | | |
| Buick | Arc | Arc | Arc | Arc | Arc | Arc | A | Arc | A | Arc |
| Cadillac | | | | | | | Arc | Arc | Arc | Arc |
| " (8 cyl) | A | A | A | A | Arc | Arc | | | | |
| Case | A | Arc | A | Arc | A | Arc | A | Arc | A | Arc |
| Chalmers | | | Arc | Arc | Arc | Arc | A | A | Arc | Arc |
| " (Mod. 6-40) | | | A | A | | | | | | |
| " (Mod. 6-30) | A | A | A | A | | | | | | |
| Chandler Six | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | | |
| Chevrolet | Arc | Arc | Arc | Arc | Arc | Arc | A | Arc | A | A |
| Cole | | | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc |
| " (8 cyl) | A | A | A | A | A | A | | | | |
| Cunningham | | | | | Arc | Arc | Arc | Arc | A | A |
| " (6 cyl) | A | A | A | A | | | | | | |
| Daniels (8 cyl) | A | A | A | A | | | | | | |
| Dart | A | Arc | A | Arc | Arc | Arc | A | A | A | Arc |
| " (Mod. C) | A | A | Arc | A | Arc | A | A | A | | |
| Delaunay-Belleville | | | | | B | A | B | A | B | A |
| Detroit | Arc | Arc | Arc | Arc | A | Arc | A | A | A | Arc |
| " (8 cyl) | | | | | Arc | Arc | | | | |
| Dodge | A | Arc | A | Arc | E | E | | | | |
| Dort | A | Arc | A | Arc | A | Arc | | | | |
| Empire (4 cyl) | A | Arc | A | Arc | Arc | Arc | Arc | Arc | Arc | Arc |
| " (6 cyl) | Arc | Arc | Arc | Arc | | | | | | |
| Federal | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc |
| Fiat | B | A | B | A | B | A | B | A | B | A |
| Ford | E | E | E | E | E | E | E | E | E | E |
| Franklin | A | A | A | A | A | A | A | A | A | Arc |
| Grant | A | Arc | A | Arc | Arc | Arc | Arc | Arc | | |
| H. A. L. | A | A | A | A | | | | | | |
| Haynes | A | Arc | A | Arc | A | Arc | A | Arc | A | Arc |
| " (12 cyl) | A | A | A | A | | | | | | |
| Hollier (8 cyl) | | | A | A | A | A | | | | |
| Hudson | | | Arc | Arc | Arc | Arc | Arc | Arc | A | Arc |
| " (Super Six) | A | Arc | A | A | | | | | | |
| Hupmobile | A | Arc | A | Arc | A | Arc | A | Arc | A | Arc |
| Jeffery | A | Arc | A | Arc | A | Arc | A | A | | |
| " (Chesterfield) | | | A | Arc | A | Arc | | | | |
| " Com'l | A | Arc | A | Arc | A | Arc | Arc | Arc | Arc | Arc |
| Jordan | Arc | Arc | | | | | | | | |
| Kearns | | | E | E | E | E | | | | |
| " Com'l | A | Arc | A | Arc | A | Arc | | | | |
| Kelly Springfield | A | A | A | A | A | A | A | Arc | Arc | Arc |
| King | | | | | Arc | Arc | A | A | A | E |
| " (8 cyl) | A | A | A | A | Arc | Arc | | | | |
| " Com'l | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | | |
| Kissel Kar | A | Arc | A | Arc | A | Arc | A | Arc | A | Arc |
| " " Com'l | A | Arc | A | Arc | A | Arc | A | Arc | Arc | Arc |
| " " (Mod. 48) | | | A | A | A | A | A | A | | |
| Lexington | Arc | Arc | Arc | Arc | Arc | Arc | | | | |
| Liberty (Detroit) | Arc | Arc | | | | | | | | |
| Lippard Stewart | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc |
| " (Mod. M) | A | Arc | A | Arc | | | | | | |
| Locomobile | E | E | E | E | E | E | E | E | Arc | Arc |
| Marion Handley | Arc | Arc | | | | | | | | |
| " (Mod 6-40) | A | Arc | | | | | | | | |
| Marmon | A | A | A | A | A | Arc | A | Arc | A | Arc |
| Maxwell | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc |
| Mercer | A | A | A | A | A | Arc | A | Arc | A | Arc |
| " (35-39) | | | | | Arc | Arc | | | | |
| Mitchell | A | Arc | A | Arc | A | Arc | A | Arc | A | Arc |
| Mitchell (8 cyl) | | | A | A | | | | | | |
| Modine | | | | | | | | | A | Arc |
| " Knight | A | A | A | A | A | A | A | A | | |
| Moon (4 cyl) | | | | | Arc | Arc | A | Arc | Arc | Arc |
| " (6 cyl) | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | | |
| Murray (8 cyl) | A | A | | | | | | | | |
| National | Arc | Arc | A | Arc | A | Arc | A | A | A | A |
| " (12 cyl) | A | A | A | A | | | | | | |
| Oakland | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | A | Arc |
| " (8 cyl) | | | A | A | | | | | | |
| Oldsmobile | | | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc |
| " (8 cyl) | A | A | A | A | | | | | | |
| Overland | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc |
| Owen Magnetic | A | Arc | A | Arc | A | Arc | | | | |
| Packard | | | | | A | Arc | A | Arc | Arc | Arc |
| " (12 cyl) | A | A | A | A | | | | | | |
| " Com'l | A | A | A | A | A | A | Arc | Arc | Arc | Arc |
| Paige | | | | | A | Arc | A | A | A | E |
| " (6-46) | Arc | Arc | Arc | Arc | Arc | Arc | | | | |
| " (6-36 & 39) | A | Arc | A | Arc | A | Arc | | | | |
| Parkhurst | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | A | Arc |
| " (12 cyl) | A | A | A | A | | | | | | |
| Peerless | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc |
| " (8 cyl) | A | A | A | A | | | | | | |
| Pierce Arrow | A | A | A | A | Arc | Arc | Arc | Arc | Arc | Arc |
| " " Com'l | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc |
| Premier | A | A | A | Arc | A | Arc | A | Arc | A | Arc |
| Pullman | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc |
| Regal | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc |
| " (4 cyl) | A | A | A | A | Arc | Arc | | | | |
| Renault | | | A | Arc | A | Arc | A | Arc | A | Arc |
| Ren | A | Arc | A | Arc | A | Arc | A | Arc | A | Arc |
| Richmond | Arc | Arc | Arc | Arc | A | Arc | A | Arc | Arc | Arc |
| Riker | E | E | | | | | | | | |
| Saxon | E | E | E | E | E | E | E | E | | |
| Scripps-Booth (air) | | | | | | | B | E | | |
| " (water) | A | Arc | A | Arc | E | E | | | | |
| " (8 cyl) | A | A | A | A | | | | | | |
| Selden | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc |
| Simplex | A | A | A | A | Arc | Arc | Arc | Arc | Arc | Arc |
| Stearns-Knight | A | A | B | A | B | A | B | A | A | A |
| " (8 cyl) | A | A | B | A | | | | | | |
| Sterling (Wisconsin) | A | Arc | A | Arc | | | | | | |
| Studebaker | A | Arc | A | Arc | Arc | Arc | A | Arc | A | Arc |
| Stutz | A | A | A | A | A | A | A | Arc | Arc | Arc |
| Velie (4 cyl) | | | | | A | Arc | A | Arc | A | Arc |
| " (6 cyl) | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | | |
| Westcott | Arc | Arc | Arc | Arc | Arc | Arc | Arc | A | Arc | |
| White | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc |
| Willys-Knight | A | A | B | A | B | A | A | | | |
| Willys Six | Arc | Arc | | | | | | | | |
| Winton | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc |

***Electric Vehicles:*** For motor bearings and enclosed chains use Gargoyle Mobiloil "A" the year 'round. For open chains and differential use Gargoyle Mobiloil "C" the year 'round.
***Exception:*** For *winter lubrication* of pleasure cars use Gargoyle Mobiloil "Arctic" for worm drive and Gargoyle Mobiloil "A" for bevel gear drive.



# The Truck That Began Right

NO Pierce-Arrow truck has ever worn out. No Pierce-Arrow truck has become obsolete. Mileages as high as 150,000 are reported. Trucks that have seen six years' service are still in satisfactory operation. There is a good reason for this record. Five years of test and experiment preceded the sale of the first

# PIERCE-ARROW

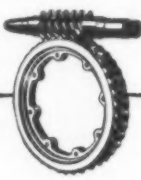
## *Motor Trucks*

During that time many experimental models were built and scrapped. Chain-driven models were tried and found wanting. Worm-gear models were developed and improved. Flexible frame and many other structural betterments were patiently worked out.

The result was that the first Pierce-Arrow truck went to its purchaser a perfect mechanism. No radical change in design or construction has been necessary in the thousands of Pierce-Arrow trucks built since.

The indisputable logic of mechanical superiority has compelled other manufacturers to adopt the worm-gear drive they so bitterly attacked when the first Pierce-Arrow truck appeared. More and more nearly the trend of modern motor truck construction has approached the lines of the first Pierce-Arrow. Set the pioneer 1911 Pierce-Arrow beside a 1917 Pierce-Arrow truck, and the difference is barely discernible. In those same six years other motor trucks have changed fundamentally in design and construction.

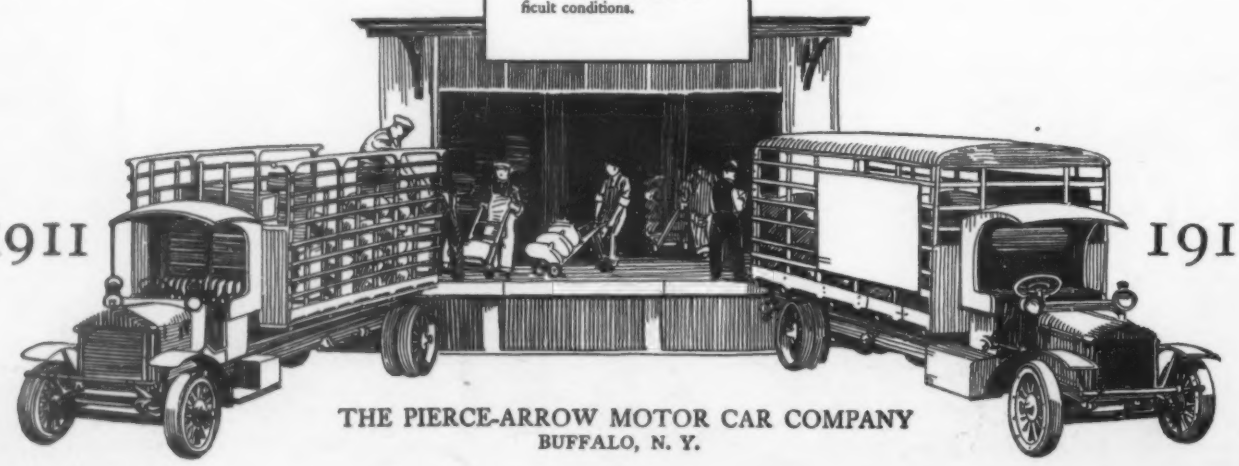
It is because the first Pierce-Arrow trucks were built on fact, not theory, that they are all in satisfactory operation today.



**The Worm-Gear**

All Pierce-Arrow trucks are equipped with the worm-gear drive, which is a positive guarantee of effective service under the most difficult conditions.

*Specific data is available covering the cost of operation of Pierce-Arrow Motor Trucks in many different lines of business, such as Transport, Grocery, Contracting, Coal, Brewery, Textile, Oil, Dry Goods, Chemicals, etc.*




THE PIERCE-ARROW MOTOR CAR COMPANY
BUFFALO, N. Y.

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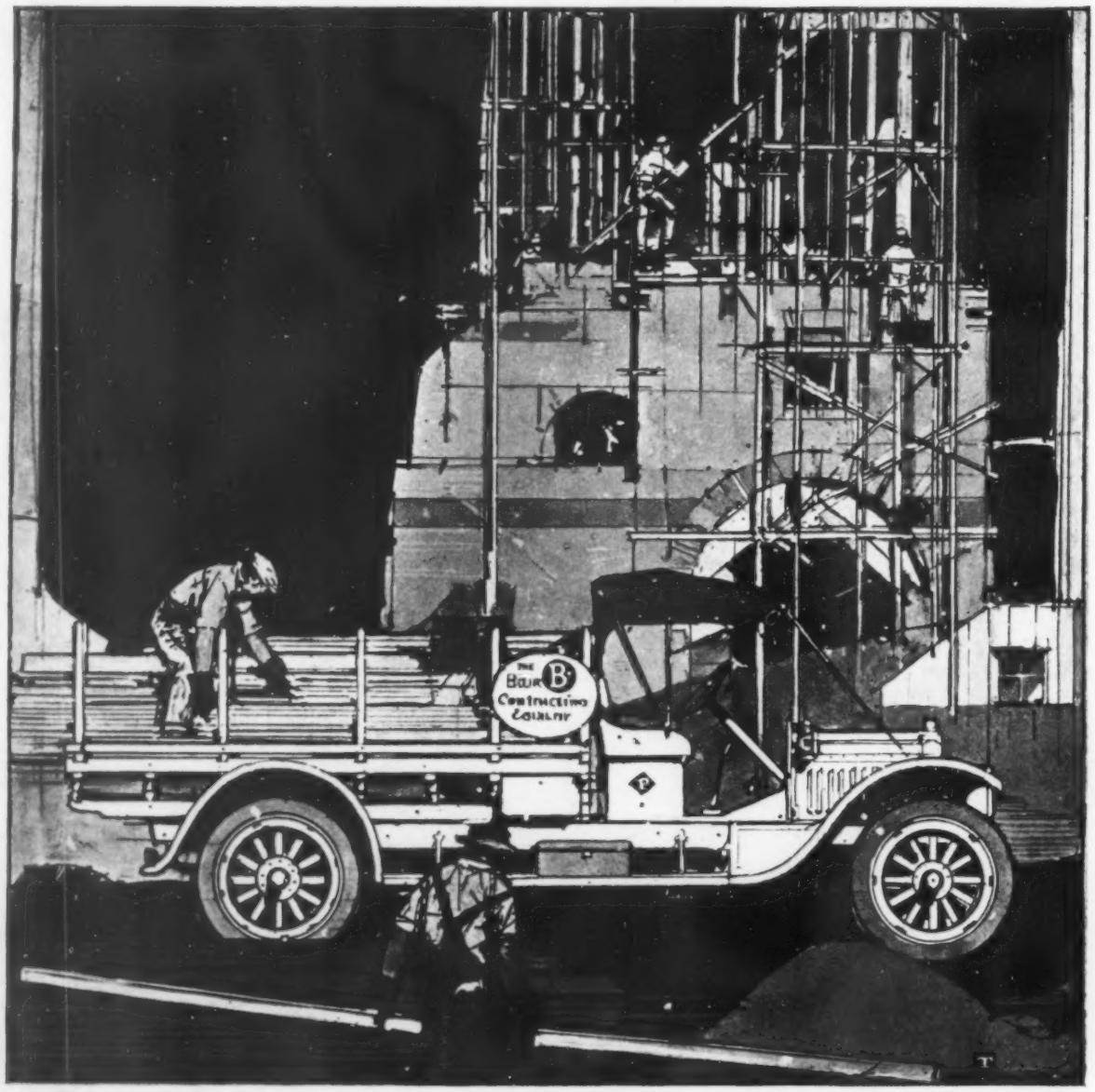
# SCIENTIFIC AMERICAN

OIL-TEMPERING THE INNER TUBE OF A SIXTEEN-INCH GUN —[See page 346]

April 7, 1917

Munn & Co., Inc., Publishers
New York, N. Y.

Price 15 Cents




# WHITE TRUCKS

**YEARS of adjustment, refinement and correction in the design and construction of motor trucks has given The White Company a practical knowledge of this work which cannot be gained in any other way. The result shows in the test of actual service. Under the racking strain of continuous year-around demands, the White Truck stands up to its work with fewer days off for repairs than any other make of truck of which we have record.**

***The broad experience behind White Construction has been supported by the largest motor truck output of any manufacturer in America; it covers every type of truck used.***

## THE WHITE COMPANY

CLEVELAND

# Cut Down Expenses

with

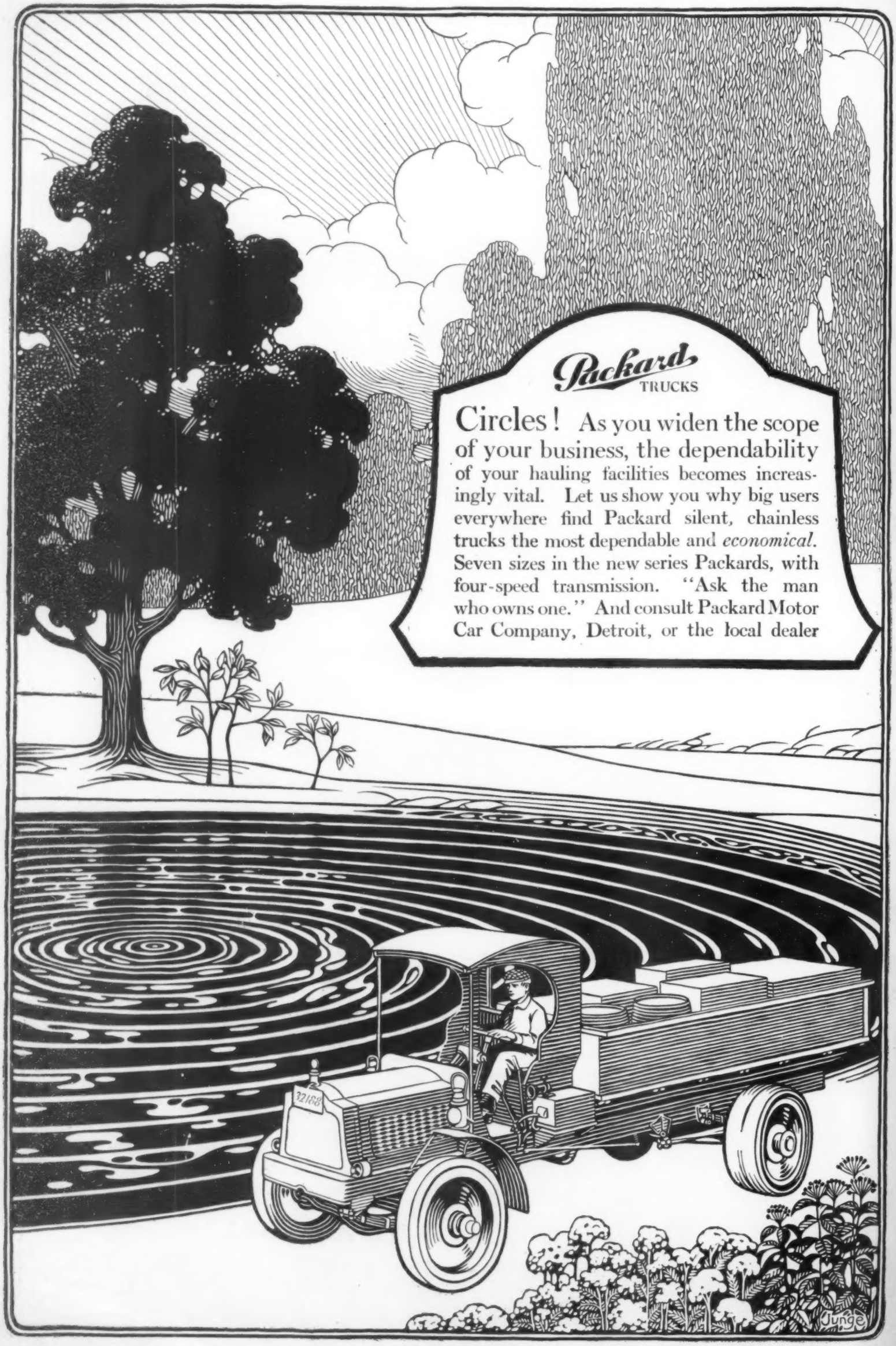
# GOODRICH DE LUXE TRUCK TIRES

You reduce both operating expenses and depreciation charges when you equip your trucks with **Goodrich de Luxe** truck tires. They make lay-ups for tire changes less frequent—likewise lay-ups for repairs to the truck.

The deeper tread absorbs much of the vibration so destructive to truck mechanism. It means long life to the truck as well as to the tire. This double saving gives truck users another reason for saying that **Goodrich de Luxe** truck tires deliver "Velvet Mileage."

Prove this conclusively by using our Motor Truck Expense Record Books which we furnish upon request.

**THE B. F. GOODRICH CO., Akron, Ohio**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